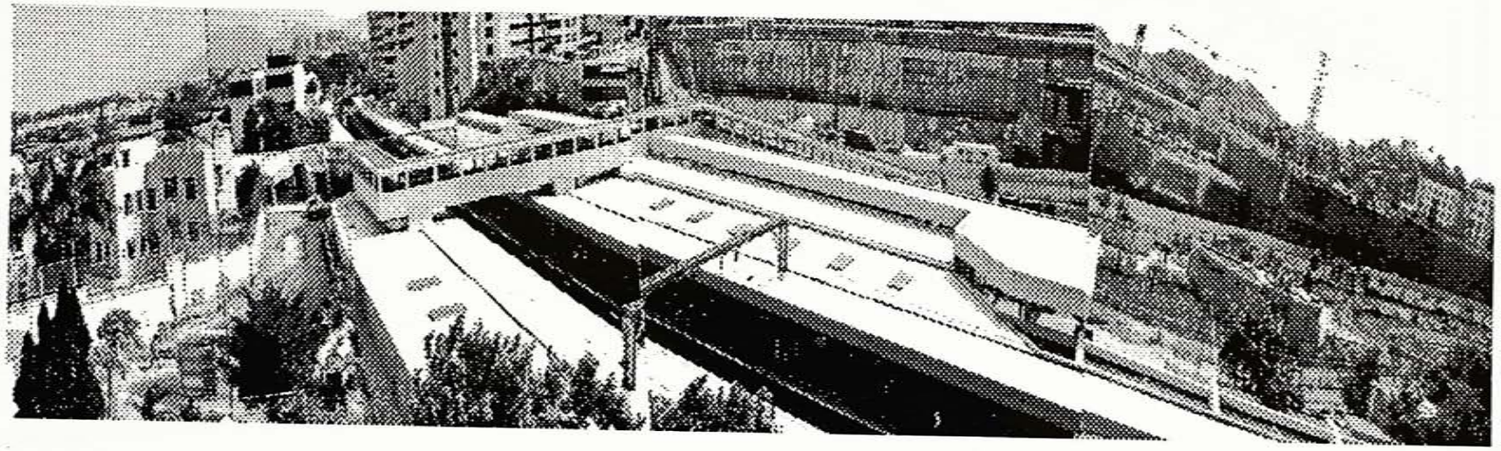
ARCHITECTURE DEPARTMENT **CHINESE UNIVERSITY OF HONG KONG**

MASTER OF ARCHITECTURE PROGRAMME 1996-97 DESIGN REPORT

KOWLOON TONG RAILWAY STATION REDEVELOPMENT

LEUNG Tak Wai April 1997

THESIS PROJECT: KOWLOON TONG RAILWAY STATION REDEVELOPMENT



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17 December 1996

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1.0 INTRODUCTION

In Hong Kong, Railway Station is a place where nearly 650,000 persons board and alight every day. For those take KCR nearly every day either to work or to school, they keep following the same route daily from the ticket office to the platform and then push against the crowds, get on and off the train. It is such a repeating and boring experience to many of the Hong Kong residents. Can it be a more enjoyable experience? In fact, apart from only providing efficient transportation facilities, it can also be a spatially fasinated and comfortable place with the provision of social and cultural needs.

Besides, the public image of the KCRC is not well established as the critizens are not satisfied by their services which include the frequent signal faults and high price charging. KCRC has always intended to promote their public image and to show their concern about their customers' needs. However, it seems that they have not paid much attention to the station design.The direct experience of the passengers in the station can be their major impression about KCRC and therefore a delicated designed station is very important as a representative for the corporation.

The intention of this project is to explore the ways to create a more enjoyable experience in and out the railway station, . Kowloon Tong Railway station is the chosen one for the exploration because of the following reasons.

Change of the area's nature

With the phrasing out of Kai Tak Airport and the release of the extensive sites for the British military and St. George School after 1997 handover, the nature of Kowloon Tong will be changed.

Future plans for development (1)

- The Government is studying proposals to turn Kowloon Tong into a new district comprising both luxury residential and commercial elements.
- Crown lands along the KCRC's railway network are the focus of potential development.
- The site on the west side of the Kowloon Tong Station has already been released and is undergoing its site work for a large commercial retail center called 'Festival Walk'.
- The 4 hectare block of Crown lands at Suffolk Road which houses the St. George School and is next to the KCR and MTR stations is being considered for rezoning to commercial area. However, the Transport Department also wants to use the site for a bus interchange terminus.

Needs for redevelop Kowloon Tong Station

- Having noticed the commercial trend in Kowloon Tong, the KCRC is interested in having property above its station and has several proposals.
- As the Kowloon Tong Station is the only station for commuting MTR and KCR and with the rapid development in New Territory and more commercial activities will take place in the district, flow of passengers will be rapidly increased. The station will take up an important role as an interchange terminal.
- The identity of existing Kowloon Tong Railway Station as an only station allow commuting KRC and MTR is not clear. After 1997, more visiters will come to Hong Kong by train and commute for MTR There is need to give the new comers a good impression and clear indication as an interchange station.
- The existing traffic condition outside the station is problematic. Taxi stand, Bus terminals, Mini-bus station and stops for school bus are all gathered outside the station along the roads that causes dangers and inconvenience for both drivers and pedestrians.
- The station is so near to the residential and schools that has been causing noise disturbance to the residents and the students. Besides, the condition of the existing waiting platform needs to be improved as it lacks of sufficient environmental protection, especially sun shading, for the passengers.

1.1 Project Objectives

- create an enjoyable spatial and social experience for the passengers
- reformulate the function of the interchange station
- incorporate a direct relationship and create an efficient traffic flow between the station and the future fabrics of the city
- explore a technical system to provide a comfortable environment for both the passengers and the local residents

1.2 Methodology

1.2.1 Research stage

- Gather the information about the existing and future city fabric of Kowloon Tong, in order to get the overall framework or constraints of the possible development of the KCR station
- Gather the details of the traffic flow around the site by existing surveys and site observation
- Gather information on site, e.g., environment, location of public facilities and etc.
- Analyze the information in term of social needs, economy, development constraints and etc.
- Study any precedents in similar scale to help forming the functional needs of the development and analyze the ways others tackled the problems of traffic flow
- Look for principles, design guidelines or needed dimensions for designing a traffic interchange

1.2.2 Brief affirmation

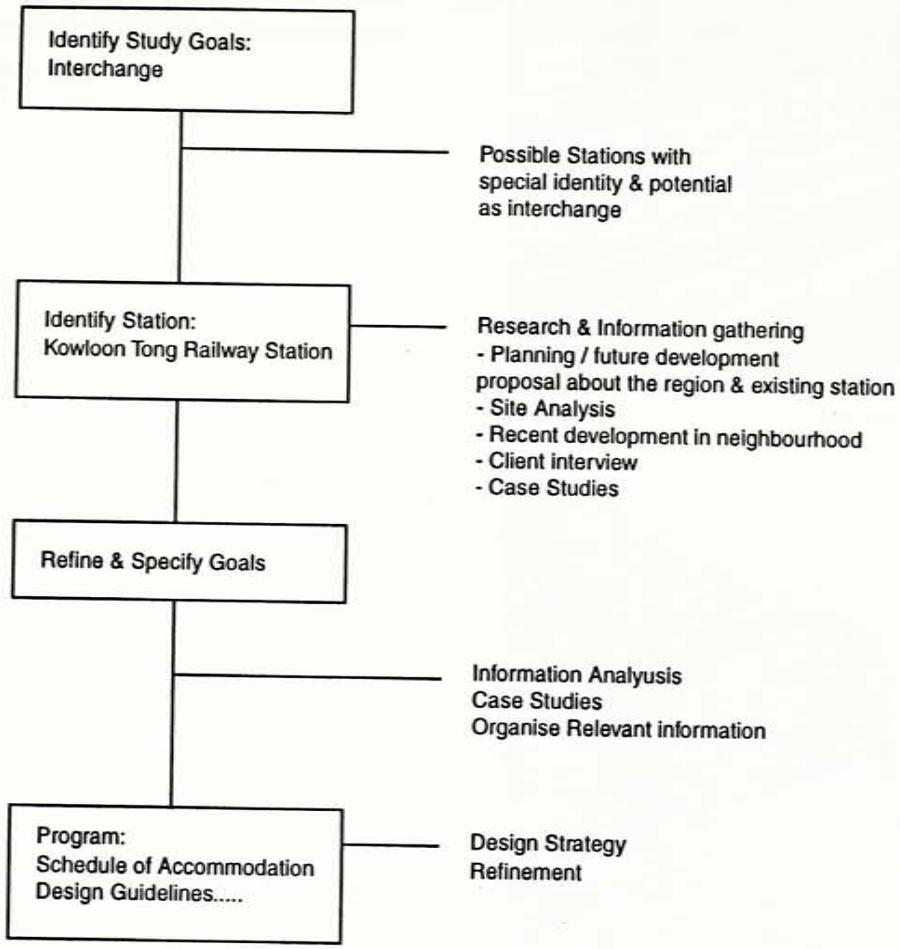
Generate a reasonable brief and some basic design criteria

1.2.3 Design stage

Explore architectural ideas to solve the problems and keep refining the design criteria

1.2.4 Detail design stage

Realize the conceptual idea and explore any innovative technological solutions



Process Diagram

2.0 BACKGROUND

2.1 Client Profile

The major client is the Kowloon -Canton Railway Corporation which was incorporated on 24 December 1982 by the KCR ordinance as a wholly Government-owned public corporation. The railway is 34 kilometers long, connecting Hung Hom in Kowloon with Lo Wu at the border, together with a loop line to the Shatin Racecourse. There are 10 intermediate stations.

The electrification and double tracking of the railway were completed in July 1983. During peak periods, electric trains run at 15-minute intervals between Hung Hom and Lo Wu with additional services terminating at Sheung Shui and Tai Po at 7-8 minute and 15 minutefrequencies respectively. Following the modernization of the railway, some 180 millions passengers now travel daily by the railway.

Now, the corporation carries four principal activities:

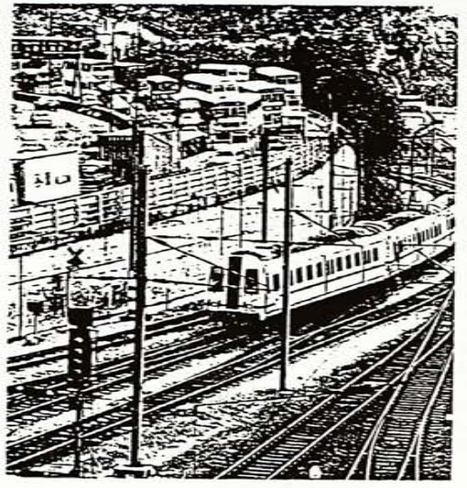
- Operation of local and international passenger services on the railway system between Kowloon and Lo Wu.
- Operation the Tuen Mun to Yuen Long Light Rail Transit System.
- Operation of international freight traffic.
- Development of associated commercial activities.

Any development proposal has to be risen up in front of the Board which is a committee consists of Government Chief Executives like the Secretary of Treasury.

Since the Kowloon Tong Railway Station is closely connected to the MTR station, any changes in either station have to be informed to each other for better cooperation. Therefore , in order to work out a better interchange and the need of expension for more escalators for MTR, in this project, the Mass Transit Railway is assumed to allow for any changes within their station if the redevelopment can also improve their problems of insufficent vertical and horizontal circulation and the lack of concourse area.

2.2 Project Finance

Since the KCRC is interested in developing the area above the railway track for commercial use, it is assumed the corporation will allow part of their future profit to improve their existing station in order to provide better services to their passengers and promote their public image.



Road Traffic and Railways

Long Distance Freight Train

Kowloon – Guangzhou Through Train

2.3 Existing conditions of Kowloon Tong Railway Station

2.3.1 Location

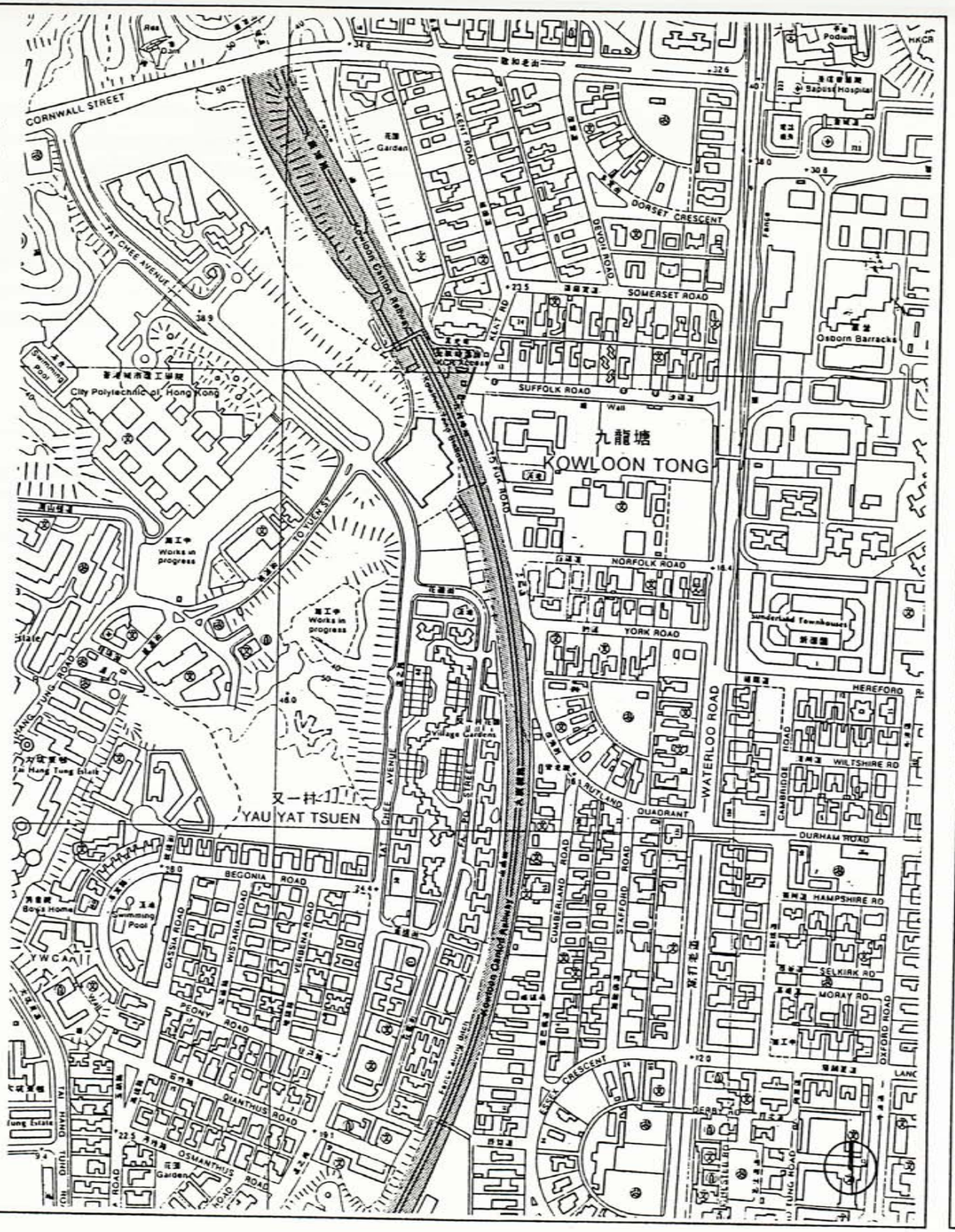
The station is on the west side along To Folk Road in Kowloon Tong. It is located adjacent to Cornwall Road Park and 'Festival Walk' which is opposite to the City University of Hong Kong on Tat Chee Avenue. There is a bus terminal along Suffolk Road and just outside the rail line on the east is the taxi queuing line which is along To Folk Road. Near the junction of Suffolk Road and To Folk Road just outside the station ground exist is where Mini-bus, school bus and cars are stopped.

2.3.2 Accessibility

Pedestrains can access to the station from MTR, from Suffolk Avenue or from Tat Chee Road. Vehicles can only access to the station from Kent Road

2.3.3 Environmental conditions

- Environmental protections to the station's platforms for sun and rain are inefficient. Since the rail line is running north and south, morning and afternoon sun directly shines to the passengers waiting on the platforms which is hot and without sufficient ventilation. Besides, since there is gap between the platform overhangs and the train, both the platforms and the passengers will get wet when it rains.
- Whenever the trains is approaching or departing, it makes a lot of noise which causes disturbance to the school and the residents nearby.



KOWLOON TONG RAIL-STATION REDEVELOPMENT PROPOSAL

2.3.4 Development Restrictions (2)

- The site is in long linear shape. Any east and west extension is not feasible as development already exists on both sides.
- Under the KCRC Ordinance, the corporation may use and permit the use of the land for railway and the other ancillary purposes for the use or enjoyment of passenger on the railway. However, any development may be disposed of by way of public auction of tender rather than simply granted to KCRC in fear of future private development in the territory.
- The site falls within a density zone 3 area according to the Density Zoning Policy approved by the ExCo. In 1966. In accordance to the HK airport Ordinance Cap. 301, the proposed development is restricted to a maximum height of 108mPD over the northern portion and 60mPD over the southern portion.
- Construction works over or under the railways can only be allowed at night after the close of normal train services to avoid any disturbance to the train services.

2.3.5 Facilities

Concourse level	**Facilities for staff** General office, Changing rooms, Staff room, office for station manager, Control room
	Ticket buying Ticket vending machines, Ticket office
	Mechanical facilities Escalators, Lifts, lift notor room, Mech. plant room, Tranformer, Passenger flow barrier
	Others Kiosks, Toilets, Store room, Police report center, Telephones, Mailbox, Bank
Platform level	**Facilities for staff** Station offices, Messenger room, Barrack, Staff's toilet
	Ticket buying Ticket vending machines, Ticket offices
	Mechanical facilities Chiller & plant room, Transformer room, Switchroom, Alternater, M & E maintenance, KCR workshop, Sprinkler tank, Pump room, Flusher, Fire services, Escalators, Lifts, Passenger flow barriers
	Others Cleaners, Kiosk

2.3.6 Users

- Travel Characteristics (3) - June 94

'Walk' is one of the most common feeding mode that means many of the 'in and out' passengers are residents living near the station and students of the nearby institutions, such as, Kowloon Middle School, Baptist University and City University which can be reached within acceptable walking distance. Other feeding modes can be MTR.

From the MVA survey, boarding passengers from the surrounding area are estimated at around 14% of the total 7600 KCR boarding in the AM peak. It is clear that the existing patterns of usage that the Kowloon Tong station is a major tansfer point between the KCR and MTR with only a relatively small proportion of passengers destinated for area around the station or area served by the bus and taxi.

The major trip purpose is to go home and to go to work. Moveover, from the 'Monthly passenger board and alight matrix',(appendix 1) it shows that the majority of passengers board at Kowloon Tong Railway Station will alight at Shatin Station (521220 persons) and majority of the passengers board at Shatin Station will alight at Kowloon Tong Station. That is because many passengers living in Shatin would take KCR as their daily transportation to work and back to home.

- Demographic Characteristics - June 94

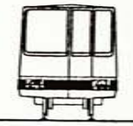
The age of the majority of the passengers is between the range 19 - 39 and most of their occupations are proffessional, clerical and students.

	Proportion of Weekday Total Patronage					
Feeding Modes	Walk	Taxi	Car	Bus	PLB/GMB	Others
In & Out Combined	21.4%	1.4%	0.6%	10.8%	2.7%	63.1%
Trip Purpose	Home	Business	School	Shopping/Restaurant	Social/Recreatiion	Others
In & Out Combined	50.6%	25.5%	5.0%	5.9%	10.9%	2.1%

Table 1 Travel Characteristics - June 1994

Sex					Male	Female
					56.5%	43.5%
Age	<12	12 -19	19 - 29	30 - 39	40 - 59	>59
	0.2%	15.2%	42.9%	27.0%	10.8%	3.9%
Occupation	Professional	Clerical	Sales/services	Production	Student	Others
	20.9%	27.0%	14.3%	13.8%	17.7%	6.3%

Table 2 Demographic Characteristics - June 1994



3.0 SITE CONTEXT

3.1 Regional conditions

3.1.1 Population

According to the 1991 Census, the population of the area was about 27000 persons.

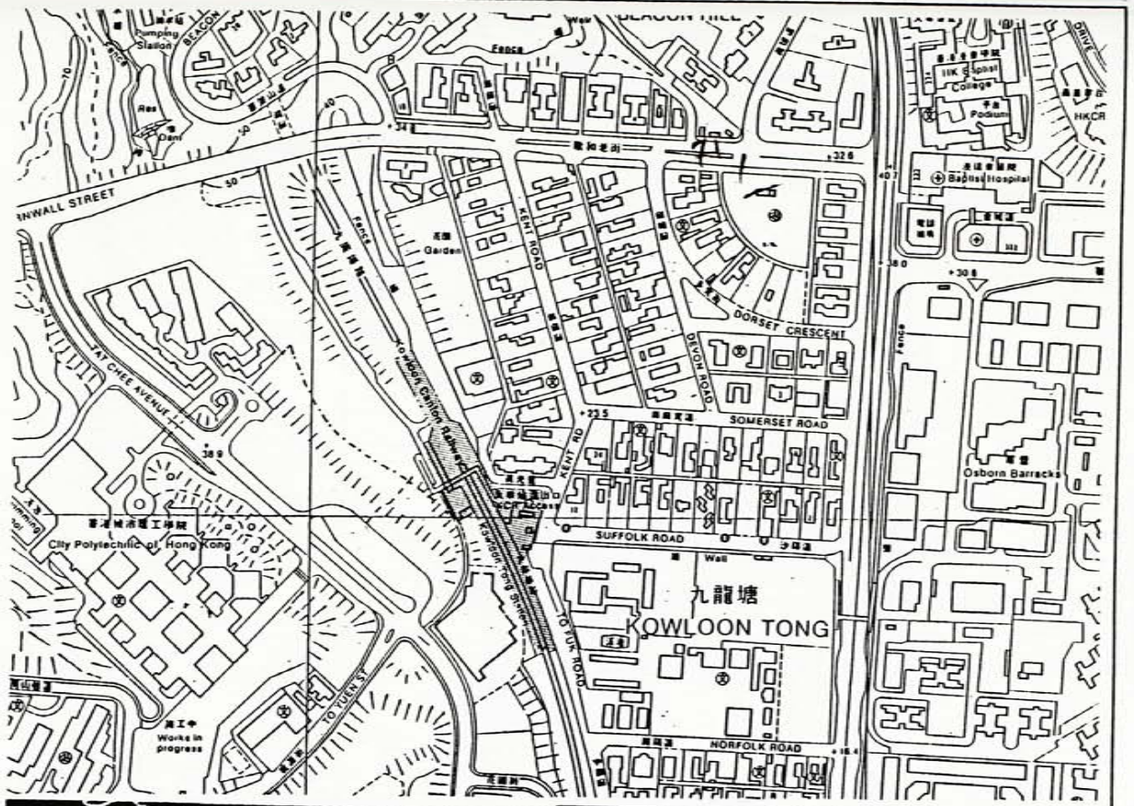
3.1.2 Topography

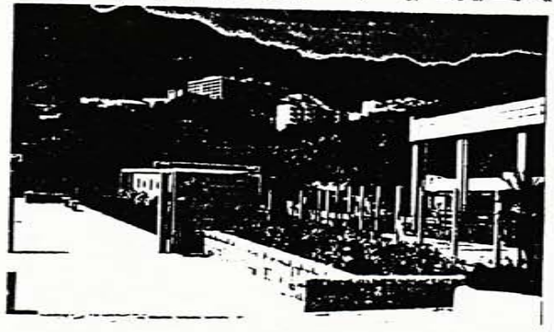
The terrain of the area is relatively flat in the central and southern part with area sloping gently to the east of Renfrew Road and north of Cornwall Street and Junction Road. To the north of Lung Cheung Road, the topography changes sharply with gradient increasing significantly towards Lion Rock.

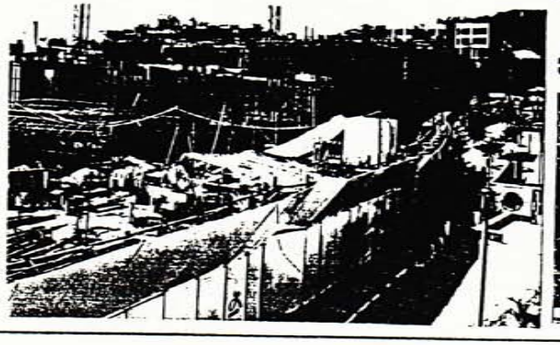
3.1.3 Existing development pattern of Kowloon Tong

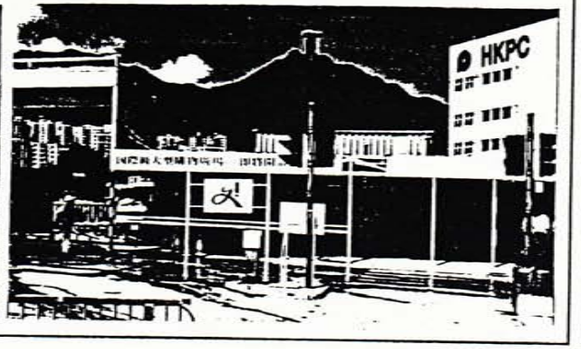
The majority of the sites are subject to different development restrictions on the maximum plot ratio and building height, originally created through the imposition of stringent lease conditions.

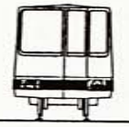
The site restrictions are imposed in order to preserve the special character and amenity of the existing developments. Moreover, the preservation of such extensive low-rise and low-density area makes an important contribution to Kowloon, by providing for variety in urban form, environment and the housing and property market.









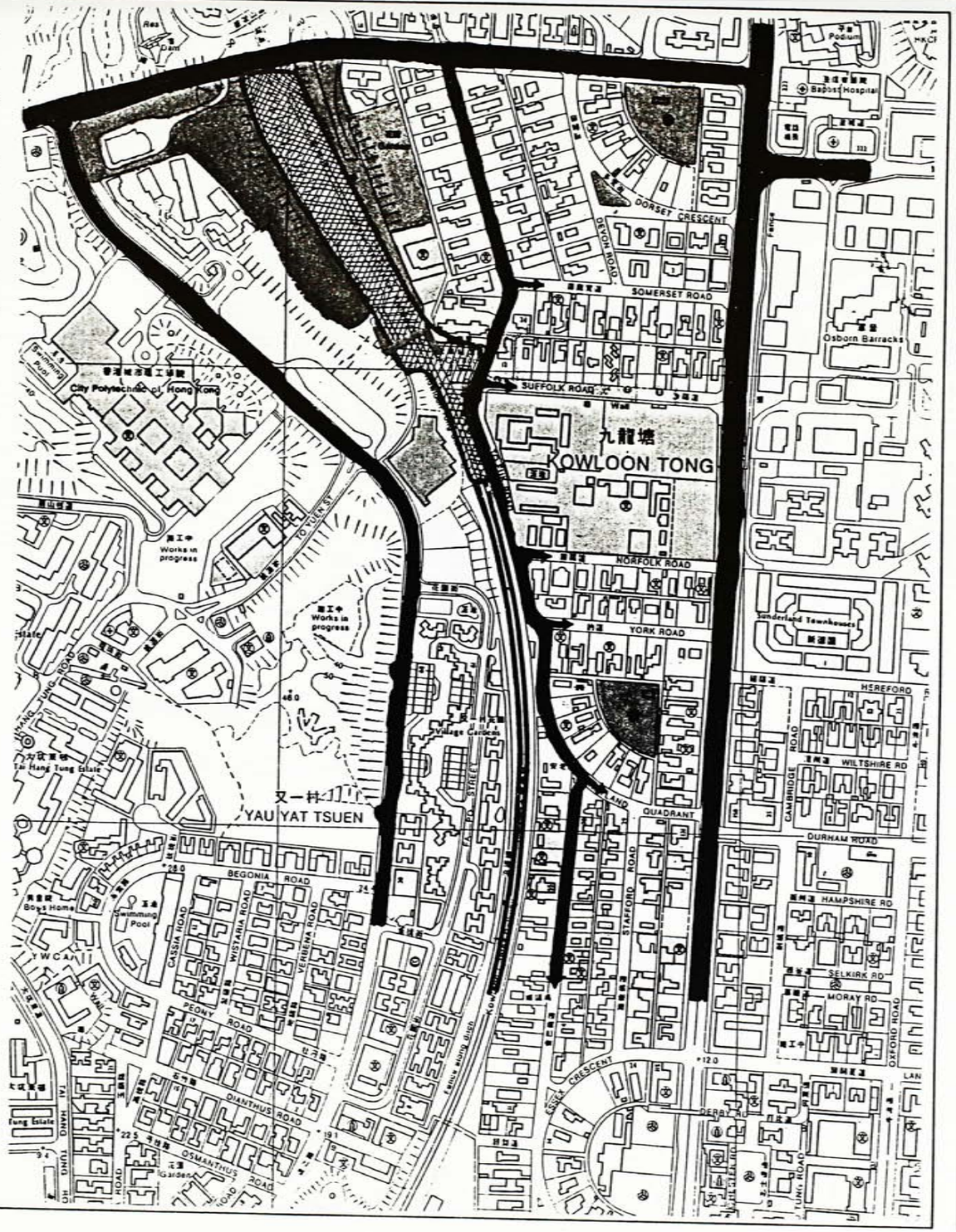


3.1.6 Land use (5)

The area is mainly characterized by low-rise and low-density residential developments, together with a significant amount of community and military facilities and institutions.

- Residential use is the predominant use within the area with 71.46 hectares. The plot ratio is between 0.6 and 3 and the building height is between 3 storeys and 12 storeys.
- The area has a high concentration of schools and tertiary educational institutes including City University, Hong Kong Baptist College and Lee Wai Lee Techinical Institute. The educational facilities available are in excess of those needed for local residents and this results in a large influx of students into the area every day.
- Other major existing facilities include the Baptist Hospital in Waterloo Road, Radio Television Hong Kong on Broadcast Drive, a petrol filling station at the northern end of Waterloo Road, two private clubs providing social and sporting activities in Waterloo road and in Cambridge Road and various service reservoirs. The existing Military Barracks and St. George School at Waterloo Road and the Military Quarters at Beacon Hill will be moved out.
- The major open space existing in the area include Kowloon Tsai Park, Junction Road Park and Lok Fu Park. Cornwall Street Park is on the west of the Kowloon Tong railway station.

3.1.7 Build Form



KOWLOON TONG RAIL-STATION REDEVELOPMENT PROPOSAL

3.1.8 Transportation

- Roads

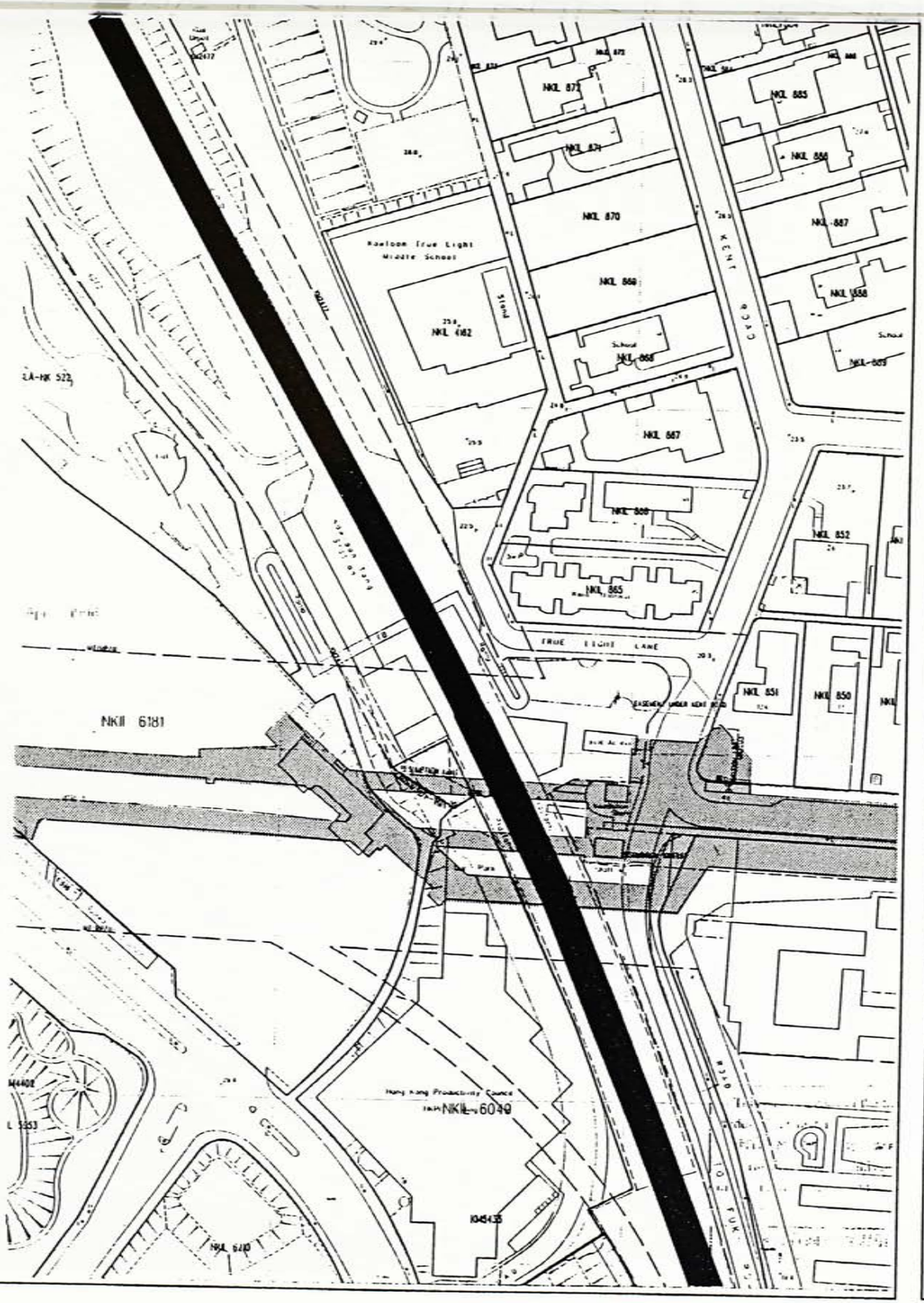
Waterloo Road, Lung Cheung Road and Cornwall Street are the primary distributors within the area, with Boundary Street and Junction Road serving as the district distributors. Tat Chee Avenue is a four lane divided carriageway which connects with Cornwall Road and Tai Hang Tung Road. Lion Rock Tunnels in the north and Waterloo Road are the major link between Kowloon and Shatin.

- Railways

1. The Mass Transit Railway passes through the area in an east/west direction. The Kowloon Tong station which has been a major interchange with the Kowloon-Canton Railway is located at Suffolk Road.
2. The Kowloon-Canton Railway line runs along the western edge of the area with the Kowloon Tong station located at Suffolk Road.

3.1.9 Infrastrucure

There is a major water supply pipe running under the ground along the west side of the station.



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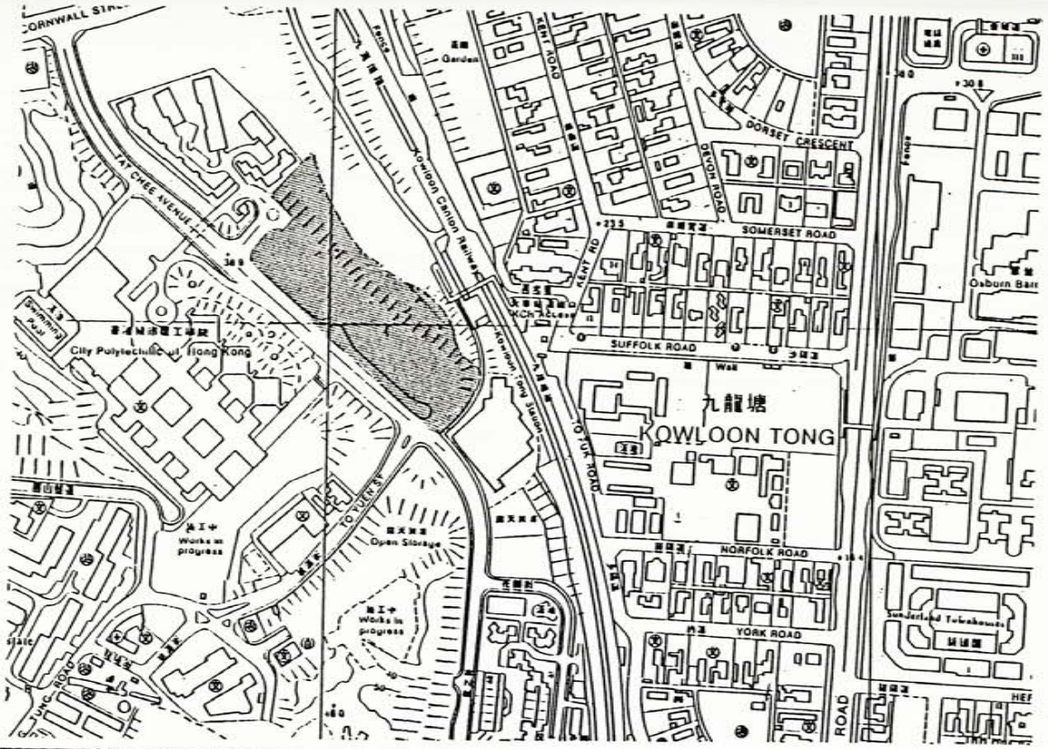
3.2 Surroundings

3.2.1 Development of 'Festival Walk' (6)

Festival Walk is a large scale retail/entertainment complex being jointly developed by Swire Properties and CITIC Pacific on a site located between the station and Tat Chee Avenue. The site is approximately 2.066 hectares in size. The development will be completed by the end of 1997 and it will comprise a mix of office and retail, two cinemas, a skating rink, a public transport terminus and an off-street multi-level car parking facility. (table 1) Besides, under the lease conditions, the development has to provide excellent accexsibility to Kowloon Tong KCR, MTR station and City University of Hong Kong.

There are 6-storeys of retails above ground level and 4-storey of office above the podium. The podium is about 26m above Tat Chee Avenue and the office is about 40m above Tat Chee Avenue.



Internal Vehicular Operation Provisions

- Public Transport Terminal

  The public transport terminus (PTT) would be for buses which currantly terminate in Tat Chee Avenue and east of the line in Suffolk Road. Bus routes 2C and 203 are assumed to remain as is and would use the new PTT. Bus routes 62R, 80M, 81M, 82M and 88M and GMB route 61M will divert to the new PTT from their existing termini in Suffolk Road. Routes 3C and 7 would be extended to PTT from Dorset Cresent via Cornwall and Tat Chee Avenue. (table 2) The PTT will provide a total of six 3.4m bays, one 7.3m bus bay, two 3m GMB bays, and two 7.3m GMB bays. The capacity of the PTT would be around 96 buses and 144 GMB per hour. During AM and PM peak periods the PTT is expected to accommodate 60 buses and 4 GMB's.

- Taxi Stand

  A peak of around 214 taxi's/hour could be expected to enter into the taxi loading /unloading area. A total taxi stand kerb of 156m is provided.

- Carparking

  A total of 1148 parking spaces are provided. The two entry barriers at the carpark level entrance should be capable of handling around 360 vehicles/hour each.

Use	Gross Floor Area (GFA)	
	Range	Adoted for TIA
Commercial [1]	82,280m² to 100,500m²	89,932m²
Office	19,400m² to 23,710m²	23,710m²
Public Transport Terminus	10,600m² maximum	9,691m²
Multi-Storey Car Park [2]	14,180m² to 17,320m²	15,089m²
Total Gross Floor Area	138,422m² maximum	138,422m²

Table 1

Notes:

(1) Included in the commercial component are cinemas with a total GFA of 4396.3m representing a capacity of 2000 seats.

(2) The multi-storeycar parking provision comprises:

Loading / Unloading Bay Provision	93 spaces
Multi-storey Car Park Provision	400 spaces
Ancillary Car Park Provision	748 spaces

3.2.2 Nearby traffic conditions

- Pedestrian

At the junction of To Folk road and Suffolk Avenue and even these two roads, there is not anyy traffic control signal and therefore the pedestrian can cross the roads at any point outsides the station. Since many vehicles load and unload along these roads and the traffic along the roads is quite heavy, pedestrians may find it insecure to cross the roads.

- Vehicle

1. Bus services

Bus routes 61M, 62R, 80M, 81M, 82M and 88M which provide services between Kowloon Tong Railway Station and Shatin terminate in Suffolk Avenue on the east side of the KRC line. Bus routes 2C and 203 which provide services between Tat Chee Avenue and Tsim Sha Tsui terminate in Tat Chee Avenue.

2. GMB services

There is now only one GMB route 61M runing between Kowloon Tong MTR station to World-side Garden stops at the junction of Suffolk avenue and To Folk Avenue.

3. Taxi

There is a taxi stand along To Folk Avenue just on the east side of the KCR platform.

4. Car

Since there are a number of kindergartens near the station, private cars are always parked along Kent Road and To Folk Avenue while the parents are waiting to pack up their children. Besides, many people take the convenience to park there while waiting for someone from the KCR station.

5. Coach

Coaches to Shenzhen and other places within Guangdong Province would take up their passengers also at the junction of To Folk Avenue and Suffolk Avenue.

- Parking

There is a lack of parking space or drop-off area.

Route Number	Origin - Destination	Frequency (Buses/h)	
		Peak	Off Peak
2B	Cheung Sha Wan to Chuk Yuen Estate	4	3
2C	Tat Chee Avenue to Star Ferry	4	2
2F	Cheung Sha Wan to Tsz Wan Shan	10	5
3C	China Fery Terminal to Tsz Wan Shan	7	3
7	Star Ferry to Lok Fu	5	3
61M	Kowloon Tong MTR station to World-side Garden	4	4
62R	Kowloon Tong MTR station to City One Shatin	9	4
80M	Kowloon Tong MTR station to Sui Wo Court	9	4
81M	Kowloon Tong MTR station to Kwong Yuen	8	4
82M	Wong Nai Tau to Mei Fu	7	5
86	Heng On to Cheung Sha Wan	10	5
86C	Heng On to Cheung Sha Wan	10	4
88M	Kowloon tong MTR station to Hin Keng	6	3
203	Tat Chee Avenue to Tsim Sha Tsui East	5	3

Table 1 Bus Routes near the station

3.3 STUDY OF TRAFIC FLOW

3.3.1 Pedestrian Flow

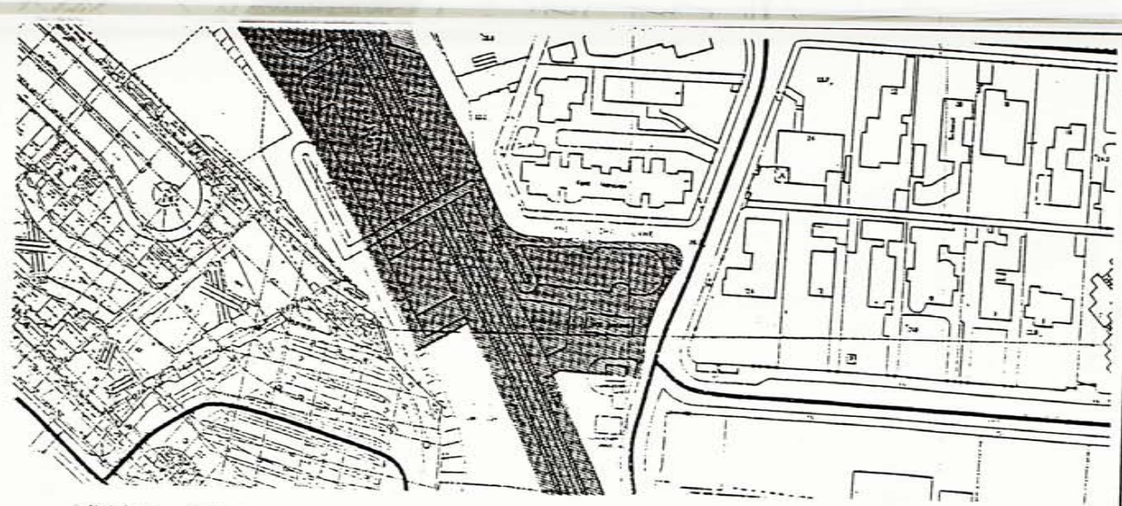
On the level of KCR and MTR concourse (6)

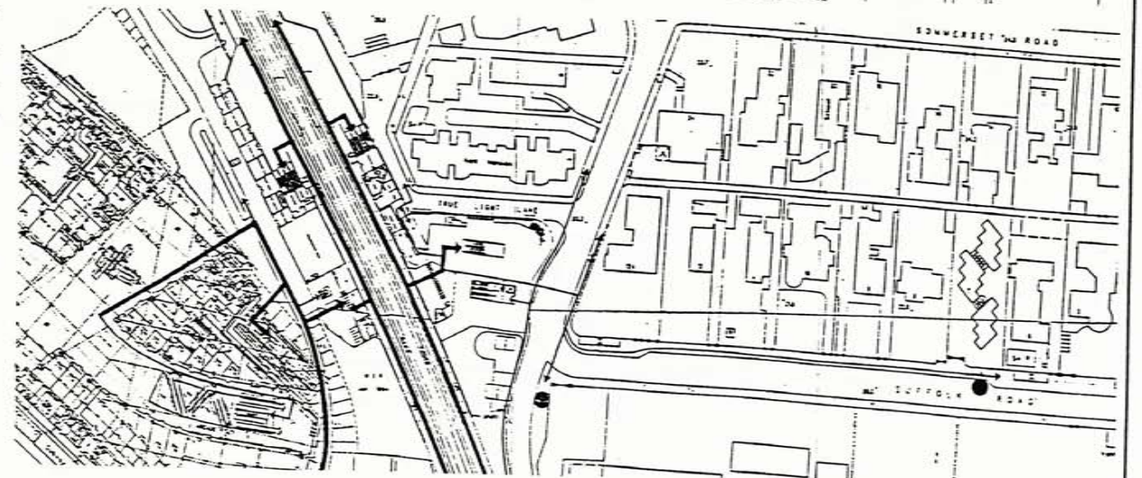
The peak time passenger flow getting in the KCR station is at 12:00 noon and the peak time passenger getting out the station is at 18:00 afternoon. Average daily in passengers number is 75522 and out passengers number is 89839. About 13-14% KCR boarding passengers are from the surrounding area. About 30-43% MTR boarding passengers are from the surrounding area.

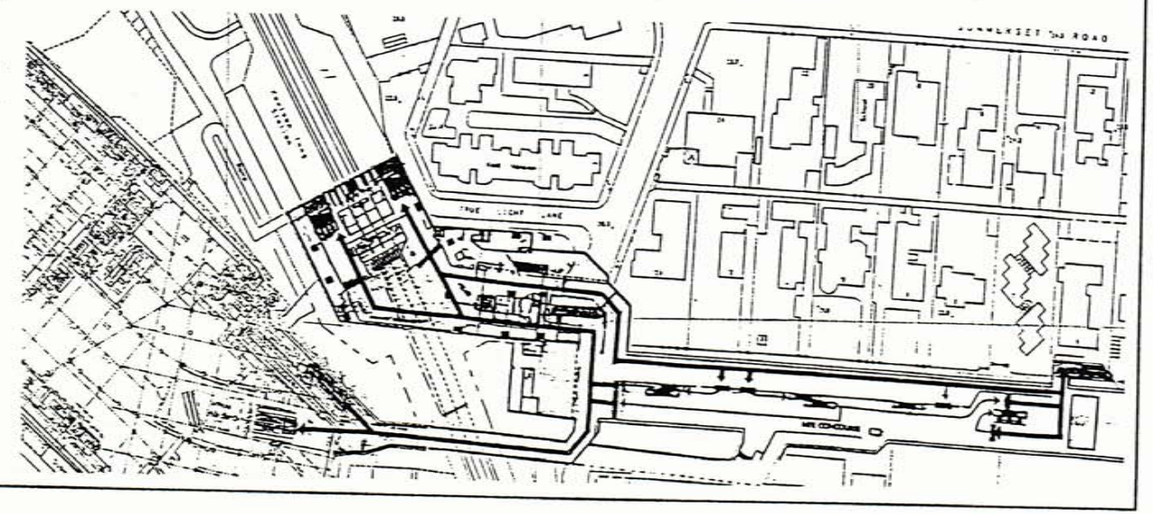
During the AM peak hour a total of 16900 passengers are estimated to alight from the KCR of which 89% transfer to the MTR. During the evening peak hour about 81% of 7300 passengers alight at Kowloon Tong Statioin transfer to the MTR while the remaining (1400) go to activities in Kowloon Tong area or tranfer to local buses and taxi.

During the AM peak hour about 6500 (66%) of the passengers alight form the MTR transfer to the KCR and 3400 (34%) are bound for the local area around the Kowloon Tong station or area served by the local bus network or taxi. During the peak hour an estimated 18000 passengers alight from the MTR of which 11500 (64%) transfer to KCR and the remaining (6500) are bound for the local area around the Kowloon Tong station or area served by the local bus network or taxi.

The Festival Walk will be linked to the MTR station via an existing 5m wide passageway and the passageway will serve bus and rail passager movement generated by the development of Festival Walk, the relocation of the bus terminal and other activities in the area. Access between Festival Walk and the KCR will be via a direct connection to the northbound platform access gates which also link via an underpass to the southbound train and the exisitng pedestrain overpass. A 10m wide entrance will be provided between the Festival Walk and KCR.

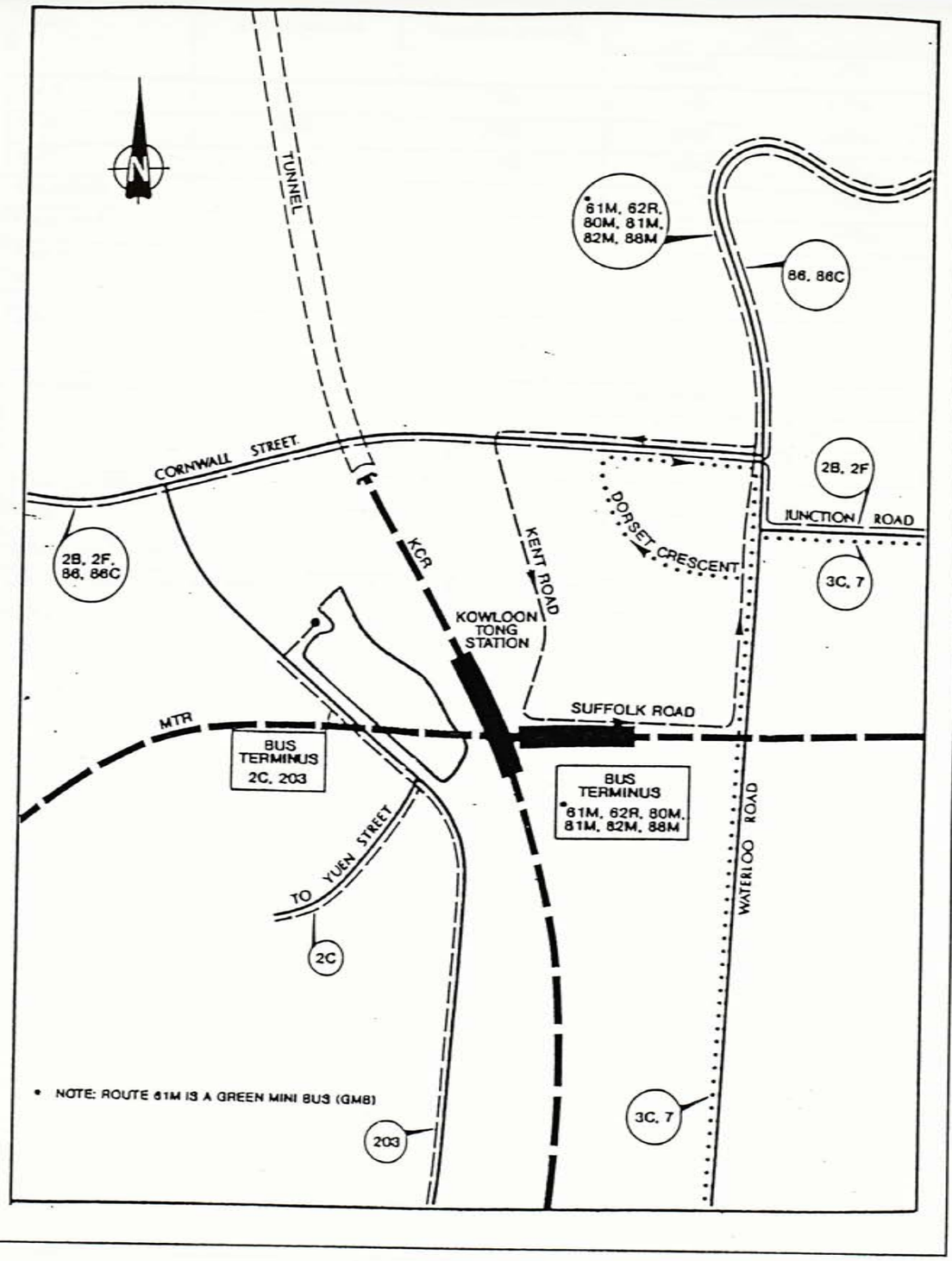






3.3.2 Vehicular Flow

The railway station can be only vehicular accessed from Kent Road which is an one way road. Vehicles can enter to Kent Road from Cornwall Street and then either go to Suffolk Road to Waterloo road or go along To Folk Road to Boundary Street.



3.3 Estimation of future traffic demand

3.3.1 Presidentrian / Passenger flow

From the traffic impact assessment done by the MVA , Festival Walk is expected to add some 6180 additional passengers to MTR and 3090 to the KCR during the evening peak.

Besides the developemet of Festival walk that will increase the traffic flow of the station, The future release of the military site and the site for St. George School for either commercial or residental development will also have great traffic impact to the station. However since there is not any development proposal released yet, the redevelopment of the station may allow feasibility for future expansion.

Any developmet above the station will also increase the passengers flow and influence the pattern of movement. The following table shows the Traffic Generation Rates used by Festival Walk. It can be a reference to estimate the traffic impact of the redevelopment of the railway station.

3.3.2 Vehicular flow

The existing bus routes which use stops in Suffolk Road are relocated to the PTT in Festival Walk will considerably increase pedestrian access distance to the MTR and KCR platform.However the existing vehicular flow will decrease as the bus and GMB routes are removed. Since Kent Road is the only vehicular access to the station and the distance between the KCR platform and the taxi stand and the parking in Festival Walk will increase, there is still a need of taxi stand, loading and unloading place outside the ground exit of KCR station along To Folk Road.

Mode	Arrival (peds/h)	Departure (peds/h)	Total	
			(peds/h)	(%)
Car & Taxi	812	733	1545	(10%)
MTR	3248	2932	6180	(40%)
KCR	1624	1466	3090	(20%)
Bus & GMB	1218	1100	2318	(15%)
Other (Walk)	1218	1099	2317	(15%)
Total No.	8120	7330	15450	(100%)
%	(52.6&)	(47.4%)	(100%)	

Table 1

Trip Generation Activity/Use	Trip Rate (pcu/h/100sq.m.)			
	AM Peak		PM Peak	
	IN	OUT	IN	OUT
Office (per 100m GFA)	0.44	0.46	0.43	0.40
Retail	0.27	0.18	0.25	0.23
Cinema (per 100 seats)	-	-	2.01	2.01
Car Park (593 Spaces) (per space)	0.262	0.080	0.159	0.126

Table 2

4.0 PROBLEMS

4.1 Unable to express the identity as a interchange for KCR and MTR

After 1997, more visitors from China will alight at Kowloon Tong Railway Station for commuting MTR to other urban area of Hong Kong. It will become the first station they pass and stay and get their first impression of the KCR and MTR services.However the existing orientation for the passengers to change between KCR and MTR is really unclear and the visitors can hardly recognise it is an interchange.

4.2 Unable to promote public image of the corporation

The station accommodates minimum facilities as just a place providing transportation services without much concern of other social and physical needs of the passengers and the neighborhood. The design of the station shows minimum attempt to create an enjoyable experience to the customers.

4.3 Insufficient vertical circulation system

There are insufficient escalators, in term of their number and width, to carry the passengers from the MTR platform to the concourse level and also insufficient vertical circulation system from the concourse level to the KCR platform. That cause jam of the vertical passenger flow.

4.4 Insufficient facilities & space

4.4.1 Loading and unloading

Many people take MTR to Kowloon Tong Railway Station as their starting point to go to the New Territories and to China because it is the only station that passengers can directly commuting MTR and KCR. For those passengers travel to China, they probably carry a lot of luggage and sometimes with a trolley. Since the location of lift to the platform is unobvious and the lift operates slowly, many passengers, espe cially the elderly would pull their luggage and even the trolley up onto the escalator. It causes danger to that passenger and others.

4.4.2 Circulation area

The circulation space especially on the platform level is extremely insufficient. The space near the escala tors and lifts on the platform of the northern line is re ally narrow that like a bottle-neck. The platform is always crowed of passengers after the working hour and since there is a lack of space, passengers are hard to circulate especially at the bottle-neck.

4.4.3 Spatial provision for the concourse

The existing concourse serves mainly as a ticket selling place and circulation area. There is not sufficient place for waiting and resting as there is limited concourse area and high level of passenger flow, and therefore any waiting activity that can block the passenger flow is not encouraged. However, since the passengers or visitors getting on and off the KCR may carry a lot of luggage and wait for friends, more spaces should be provided for waiting and resting near the concourse.

Besides, the increase of passenger flow also indicates the need of more spatial provision for the concourse.

4.4.4 Auxiliary facilities

There are only a few supporting facilities available in the existing station. Howvere as an interchange which many passengers pass by every day should provide more auxillary facilities, e.g. post office, caferteria or even barber shop and etc for the convenience of the passengers.

4.4.5 Weather protection for the platform

4.5 Insufficient interaction to the neighborhood

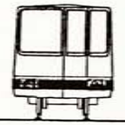
The station or the railway both physically and functionally shows insufficient linkage to the whole urban area however it is a place where most of the visitors or local residents pass by every day.

4.6 Inconvenient linkage to the taxi-stand

Since all of the existing bus and GMB will be relocated to the Festival Walk. Passengers who alight either from MTR or KCR to commuter bus or GMB will have to go to Festival Walk which is relatively further than the existing stops which are just outsides the station on the ground level at To Folk Road. The relocation of the bus, GMB and taxi stand will be on level 3 of Festival Walk. That means the passengers from MTR or KCR have to go up 4 to 5 levels in order to get to the public transport termi -nal. The taxi stand is even further from the terminal. For the passengers taking a lot of luggage and probably choose to take the taxi will have to take a relatively longer distance if they take taxi at Festival Walk. It will be much more convenient if there is still a taxi stand maintained outside the station.

4.7 Noise pollution to the neighborhood

As there is a middle school just adjacent to the railway, the trains cause noise problems to the school.



5.0 DESIGN PROGRAM

5.1 Mission

To explore the possibilities to redevelop the existing station to be a significant interchange for KCR and MTR which is able to:-

i. show the clear orientation and identity

ii. provide sufficient circulation space and vertical cir culation system

iii. accommodate sufficient supporting facilities

iv. improve linkages to the surrounding urban area the interchange should provide a 24 hour open path linking the eastern and western area along the track

v. fulfil two special requirements from the client
-create a clear interchange for both corporations, KCR and MTR but still maintain clear seperation as MTR and KCR are actually two separate corpora tions which require different management.
-the design should consider how the stations oper- ate during the construction period which means the redevelopment phrasing is important and disturbance should be minimized.

5.2 Schedule of Accommodation

Station

Concourse
Ticket selling mechines and office
Waiting area with lockers
Storeroom

Passenger services
Customer service counter
Newspaper stand
Chemist
Post office
Bank
Kiosk / coffee shop
Tourist information counter
Telephone
Toilets
Police post
Gift shops

Station control & operation
Control office
General office
Staff room
Battery & apparatus
Station Manager room
Workershops
Maintenance room
Operation / Engineer office

Staff facilities
Staff changing & rest room
Pantry
Toilets

Platform
Inspector office
Duty room
Workshop
Storeroom
Cleaner
Toilet
Platform

Technical support
Mechnical plant room
Transformer room
Refuse chamber
Lift motor room
Switch room
Flusher
Fire services
Sprinkler tank
Pump room

Hotel Complex (3 star hotel)

Guest rooms (300 rooms)	@ 60-70sq.m.
Seminar hall	
Meeting rooms	100sq.m.
Bussiness center	1000sq.m.
Banquet hall	
Fitness center	100sq.m.
Restaurant	200sq.m.
Cafeteria	100sq.m.
Retails	
Back of house	
Parking	

Exhibition

Exhibition hall
Gallery

5.3 DESIGN GUIDELINES

According to the 'Design and Construction Guidelines' done in the 70's by Freeman Fox, Wibur Smith & Associates for the entire rapid-transit system, several functional design criteria were established.

Running Track

The minimum width of the tunnel is 13 feet. For design purposes a headroom of 14 feet was assumed.

Station Mezzanine

Function

The principal function of the mezzanine is to provide for the movement of people to and form the trains and for the activities associated with that movement. It often serve a secondary function as a pedestrain subway and therefore most of the mezzanines have been designed so that there is free movement between all access points. The main activity is of paying the fare, so the mezzanine must hiouse booking offices, ticket vending machines and control barrier. The headroom of the mezzanine should be at least 10 feet.

Facilities

The other facilities required in the mezzanine divide into two main categories: those required in connection with the operation and those for the convenience of the public. Of the first category, the most important is the station master's office. this will contain public address equipment for both the mezzanine and the platforms and means of communication with the control center at Kowloon Bay Depot. At interchange station, closed circuit television should be installed to ensure adequate station supervision.

Space must be provided in the mezzanine for the rest room for station staff and staff rooms and canteen facilities for train crews at selected stations. Besides, space for a small operational and store room s for items ranging from cleaning equipment to tickets, space for escalator or lift machinery, rooms for housing of train control apparatus and accommodation for ventilation equipment and electrical substations.

The facilities required for the convenience of customers include illuminated direction signs, information booths, concession countersfor the sale of newspapers and other selected commodities, lavatories and first-aid facilities.

Access

Most underground stations have been designed with a mezzanine level under a major road and above the station platform. Access to the mezzanine should be provided from both sides of the road. Where there is road junction above, then access should be provided from all corners of the junction. All station should have at least four major access points. In addition to the main entries, the owners of neighbouring properties should be given the opportunity and even encourage to provide their own entries.

Platform

The stations have 600 foot long platforms of 12 foot clear width to accommodate eight-car trains. the structural headroom on the platforms should be at least 10 feet so that signs can be installed at sufficient height to be visible to passengers.

For all upward movements of more than 12 feet, escalators have been assumed.

Escalator

For design purpose, the capacity of an escalator of about three feet in width, was assumed to be 8000 people per hour.

Stairway

Three widths of stairway were used; 6 feet, 10 feet and 12 feet.

5.4 Design Strategy

Although there are many problems need to be solved in this project, they are not in equal important. There fore the sequence of solving which problem first is needed. In a station design, providing efficient circulation, clear interchange path and convenient linkages to surrounding urban area are the fundamental requirements.

Circulation Strategy

-separate the circulation routes for different purposes

-provide visual connection for the passengers between KCR and MTR platform to indicate interchange orientation

-provide `wandering' path\area for passengers to en joy the space while providing a fast route for those in a hurry

Zoning Strategy

-create a node connecting MTR and KCR station to avoid intergating the two corporations into one

Surrounding Linkage Strategy

-create 24 hour open path through the interchange to connect the eastern and western area along the KCR track

Identity Strategy

-create a focal point for the interchange

The design sequence in this project is to first explore the options which can provide greater achievement of the above requirements. The options include:

-change of the MTR, KCR or both railway location

-change of MTR railway level

-change of KCR or MTR platform level

-change of the concourse level

-change the distance between MTR and KCR

-using different portion of the adjacent sites

In order to eliminate the number of options, pro and cons for each options will be list out. The selection of potential option will be based on the highest level of achieving the fundamental requirements and the project missions.

CASE STUDY:

Waterloo International Terminal, London

Architect:

Nicholas Grimshaw & Partners

Capacity:

Able to transit up to 6000 passengers every hour.

Design Philosophy:

At the Waterloo International Terminal, there is a great deal of sense in making the operation as much like air travel as possible, since it has to cope with the problems of international airport: customs, passport control and so on, and rationalize those of traditional rail stations where masses of people alight from the incoming trains to be met with passengers battling to get on.

Besides, the high visibility of the trains will be a treat to constantly remind Waterloo of its connection to the world.

Zoning Strategy:

It is decided that the different elements of the station: departures, arrivals and catching or leaving the trains should be separated and the functions are decided to be separated by level.

Ticket check, security and so on will take place in enclosed, submerged passenger handling zones, each of which is linked to separate concourses.

The passenger handling zones are each connected to a platform by escalator and lift. The platforms are kept as clear as possible to permit constant mobility and unrestricted views down the train shed.

Facilities:

The concourses offer services like shops, restaurants, bars, bank, bureau de change and so on.

Form:

The shed shimmies down the length of the platform following a gentle curve and tapering from 55m in width to 35m at its narrowest end.

Structural System:

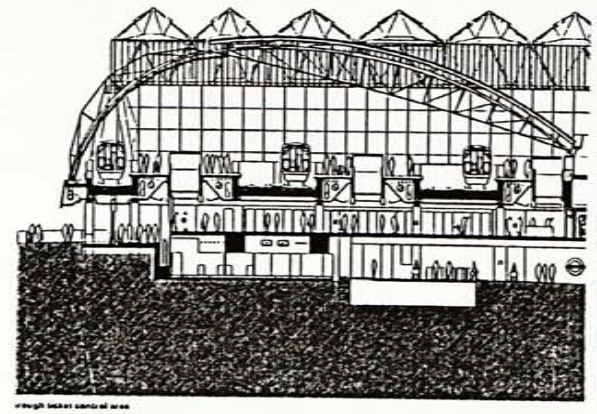
The basic shape of the shed is obtained by making a series of three-pinned arches, each made of two bow-string trusses. The eastern trusses are longer with tension rods inside. the shorter western trusses are reversed with tension rods outside and the cladding is all of glass.

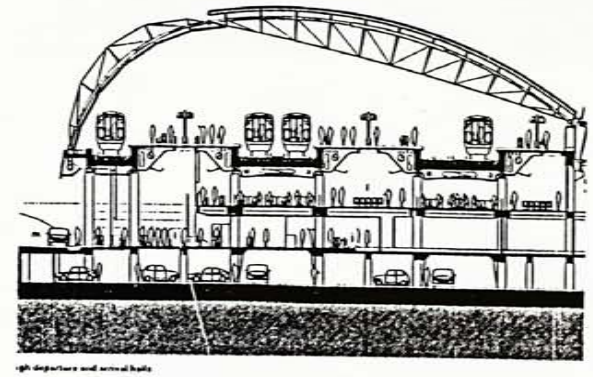
Materials:

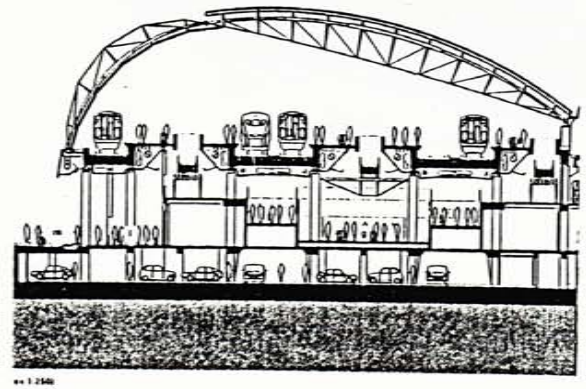
The shed is glazed and clad in matte finish stainless steel which is used on the east side to reduce heat gain from the sun..

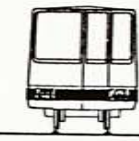
Movement System:

A complicated system of electrically operated partitions in the circulation space to the south of the departures hall (which is dominated by a huge central travelator) prevents arriving and departing passengers becoming mixed up. Those on their way in are deflected down gentle ramps to the customs hall under the departure lounge.









CASE STUDY: Stadelhofen Station, Swiss (8)

Architect:

Santiago Calatrava

Design Philosophy:

The project attempts to give an answer to the problem of the peculiar topography of the site. It is s typical <design by section>.The cross section which is split up into three levels: the covereed promenade, the cantilever platform roof, and an underground shopping center.

Zoning Strategy:

There is a promenade propping over the inside express track near the hillside. Beneath the tracks is the shopping mall.

Facilities:

Beneath the central tracks, a ribbed concrete chassis defines a subterranean concourse flanked by shops that bets some natural light from the pavement lights along the platform edge.

Form:

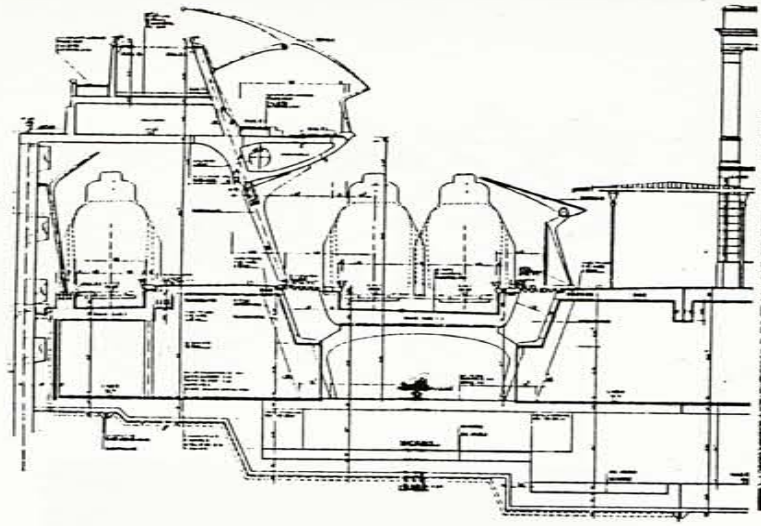
A glass canopy on the outer platform reaches towards the pergola on a black steel structure that makes its own visual connections with the forms of steel pergola and props which stand out against the pale gray concrete.

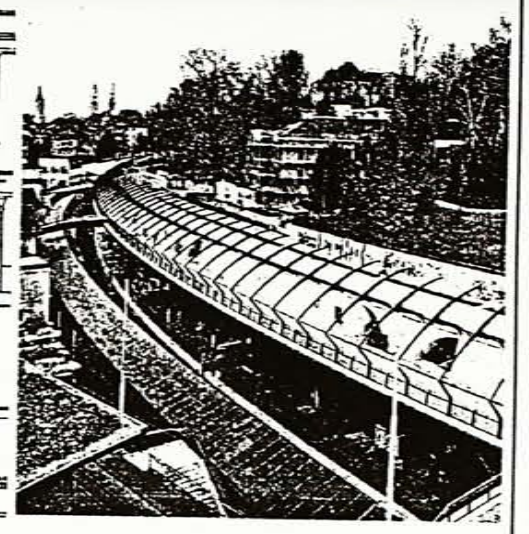
Used Materials:

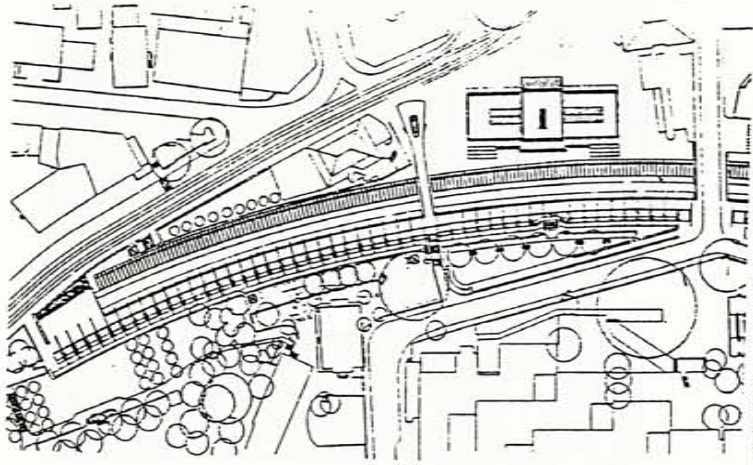
Steel and concrete are used with sculptural virtuosity.

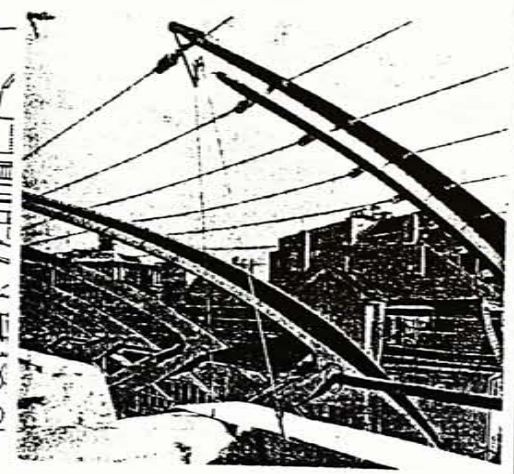
Movement system:

The public pass between central and outer platform by stairs, escalators and lifts through the underneath concourse. There are lifts rise past the central platform to serve as well the upper promenade which is connected to the platform by free flights of stairs at regular intervals. The public can pass freely right through the station as well as over it by the bridges that connect the upper promenade directly down to the outer platform and square. Together with the upper promenade's connections to local streets at its ends and at points along its length, the whole station is made porous to pedestrians.









CASE STUDY: Kowloon, Hong Kong (9)

Architect:

Terry Farrell

Capacity:

The station measures 300m by 180m.

Design Philosophy:

The station is like an iceberg with the larger part underground concealing its actual size.

Facilities:

The station will contain check-in counters for the airport, traffic interchange, parking and so on.

Form:

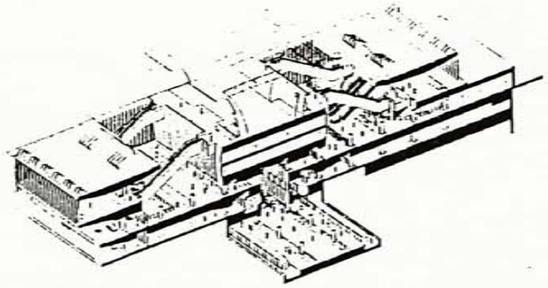
Above ground the station is simple and monumental. The gently arched roof raised up on glass walls is forcefully interrupted by four towers. The center between the towers is open, forming a giant triumphal arch or gateway providing shade for the station entrances.

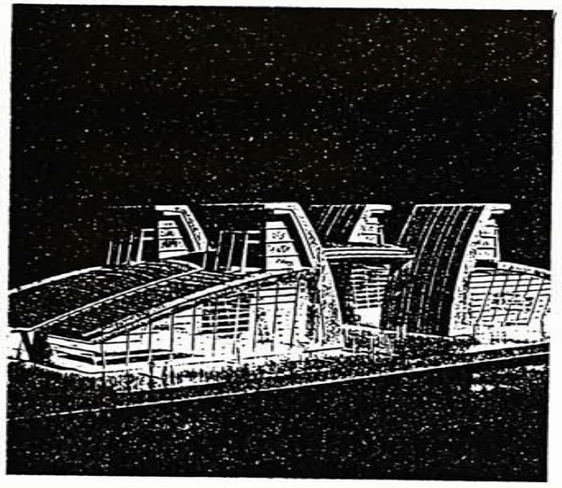
Used Materials:

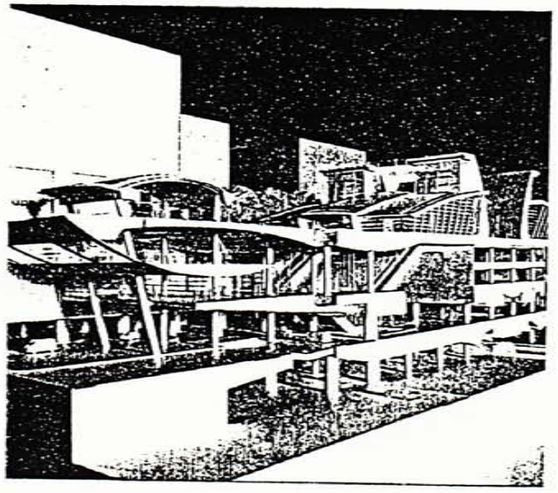
Concrete with silver roof cladding

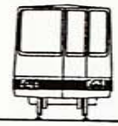
Special Features:

The concourse is a lofty space offer the possibility of natural ventilation and transparency. Farrell has introduce wells carrying light down three or even four storeys. Besides, the ventilation building for the railway and KVB is highly sculptural.









CASE STUDY: Abando, Spain (10)

Architect:

Michael Wilford and Partners

Design Philosophy:

To rationalize public transport in the city bringing together buses and several historically distinct railways under one roof. The result is a transport interchange on several levels crossed by public walkways and with a range of facilities.

Zoning Strategy:

The lowest level is devoted to car parking; on the next level , still underground, is the bus station. Buses enter and leave by ramps, moving round in a continuos loop. Above this, is an intermediate level of shopping and the platforms. On the level beyond are the main station platforms. Under the highest part of the roof are offices and the departure lounges. In front of the terminus is a plaza with a drop-off point. There is a cafe restaurant above overlooking the plaza.

Facilities:

The station includes car parking, bus station, shopping, offices, departure lounges and cafe restaurant.

Form:

The train shed consists of great arc with a spectacular 166m wide column free span covering twelve tracks.

Structural System:

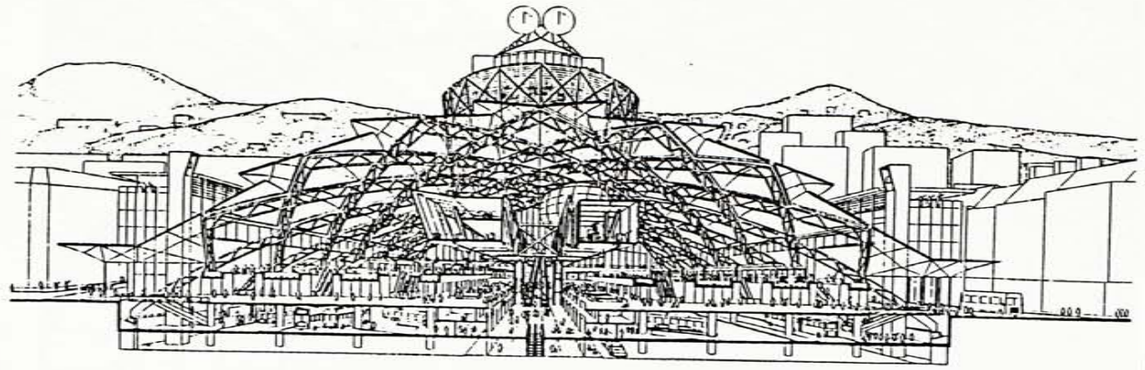
The roof is carried on a lattice of diagonal trusses and consists of a series of overlapping petals, alternatively clear and translucent which let the air in and keep water out.

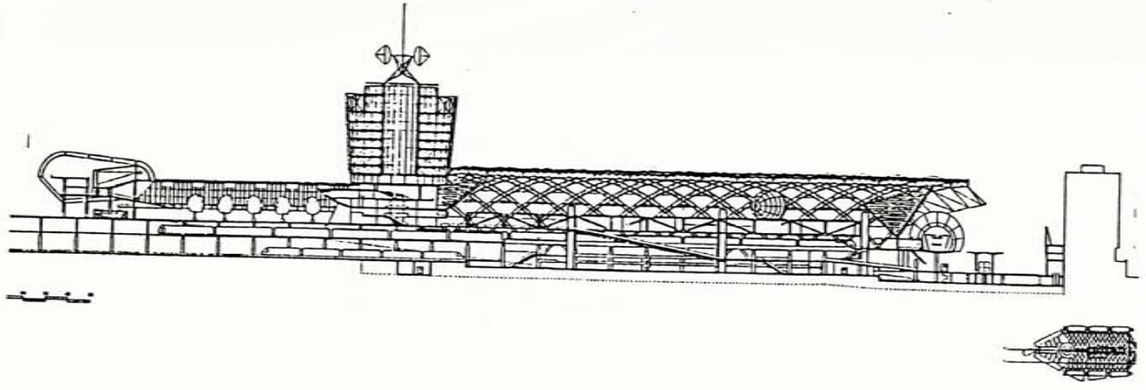
Used Materials:

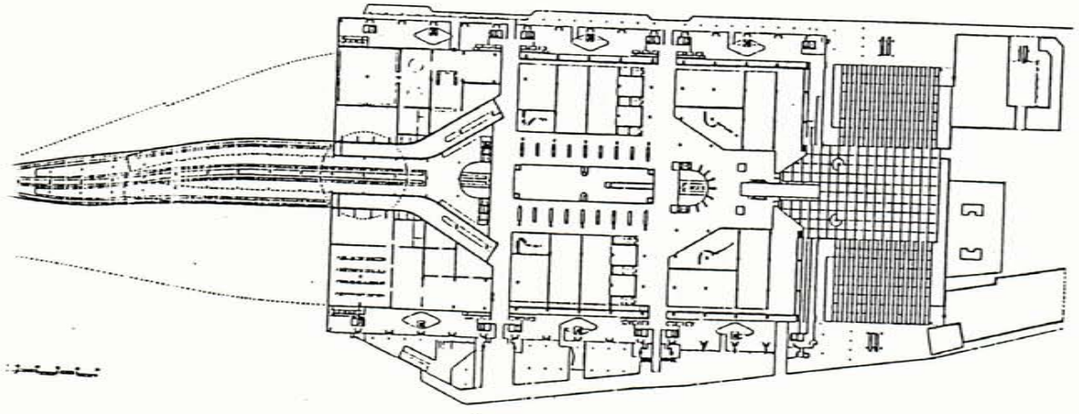
The entrance of the station is sheltered by a suspended glass screen which is supported by the steel trusses.

Movement system:

The main circulation nodes, lifts and escalators, are grouped in the central spine of the terminal.







CASE STUDY: Brin Railway Station, Genoa (11)

Architect:

Renzo Piano

Design Philosophy:

The station is analyzed and arranged into individual structural elements which are grouped according to their various functions (cladding, lighting, graphic and etc.) The station's design is a combination of these components which are instantly recognizable for users and thus ensure easy orientation and safety.

Zoning Strategy:

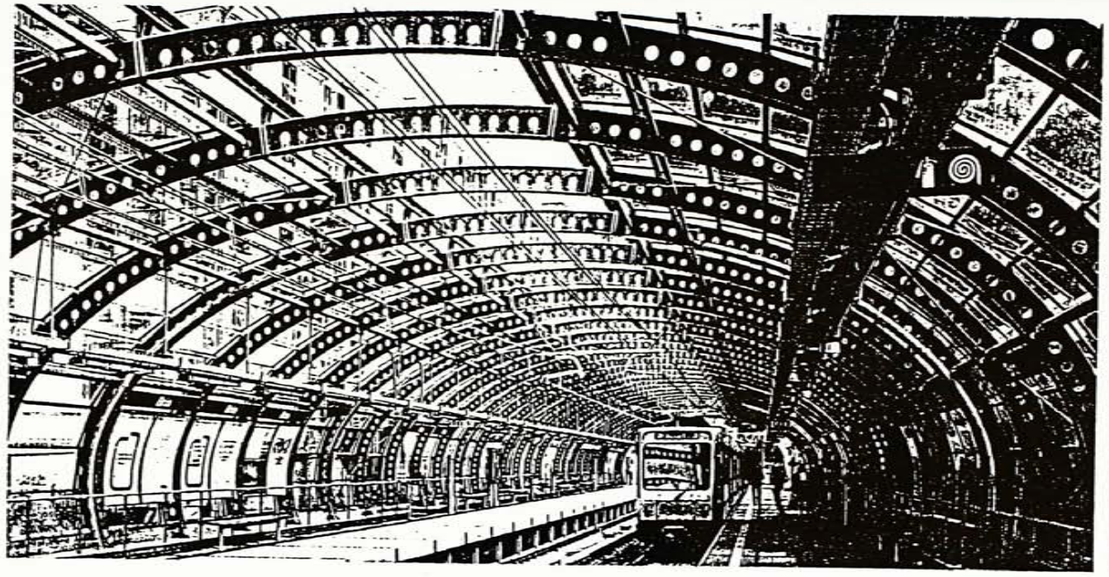
The station is divided in two parts: the first consists of rails, platforms and entry points; the second is the access areas from the street level forming the linkage between the station and the city.

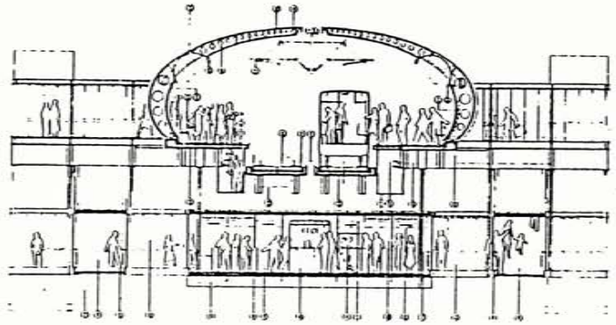
Form:

The shed is like a tube that wraps around the tracks.

Structural System:

The shed is composed of a series of arches that are formed by pieces of steel beams. Clear glass is placed between the skeletons and the top of the shed is left open for nataural ventilation.





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Footnote

(1) News on South China Morning Post

(2) Thesis by Sophia Siu, Hong Kong University, 1995

(3) Report by MVA for Traffic Impact in Festival Walk

(4) Thesis by Sophia Siu, Hong kong University, 1995

(5) Information from Planning Department

(6) Report by MVA for Traffic Impact in Festival Walk

(7) Architectural Review

(8) Santiaqgo Calatrava 1990-1992, El Croquis, Italy, 1992

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(10)

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(12) JA 1993-4 Arata Isozaki

2.0 DESIGN PROCESS

The high effectiveness of the circulation system within the interchange is the major or basic requirement. The most important message the Railway Corporation tends to convey is the high level of convenience and speed in their service. Therefore the project started with the target of finding the most effective circulation system within the existing environmental constraints.

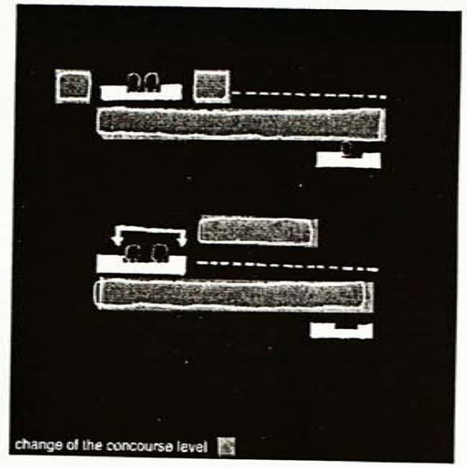
2.1 Site Selection

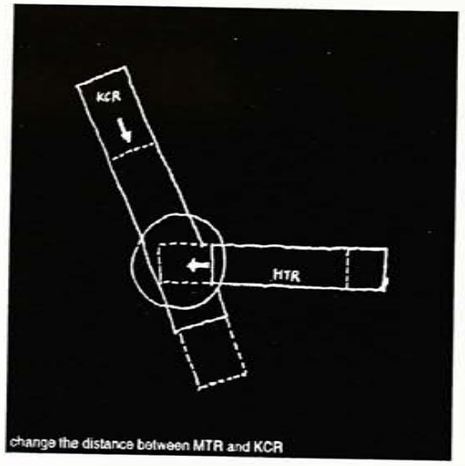
Four adjacent sites have been selected for prelimary studies to see their pontential for creating an interchange with sufficient and efficient circulation system.

The followings are options that also vary the circulation system for different site location:

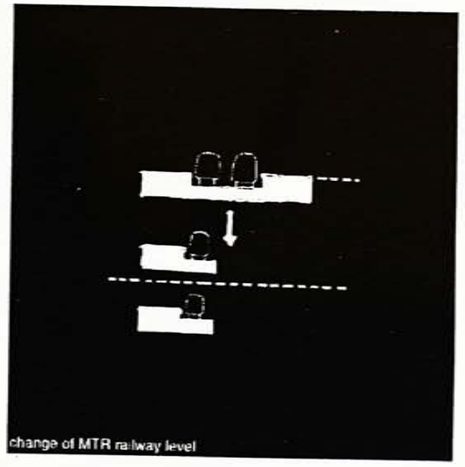
- MTR, KCR or both railway location
- KCR or MTR platform level
- Horizontal distance between MTR and KCR platform
- KCR railway level
- Concourse and entry level

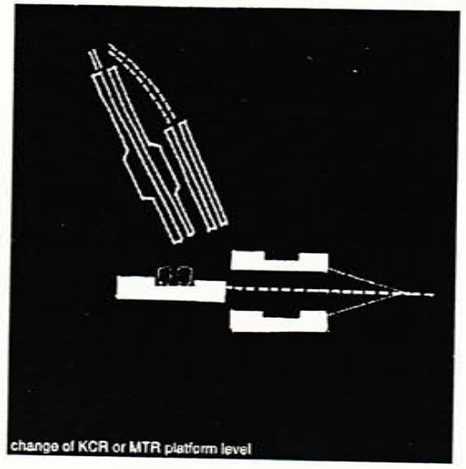

using different portion of the adjacent sites

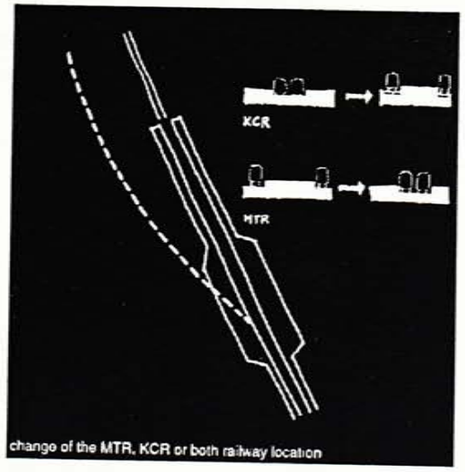

change of the concourse level



change the distance between MTR and KCR


change of MTR railway level

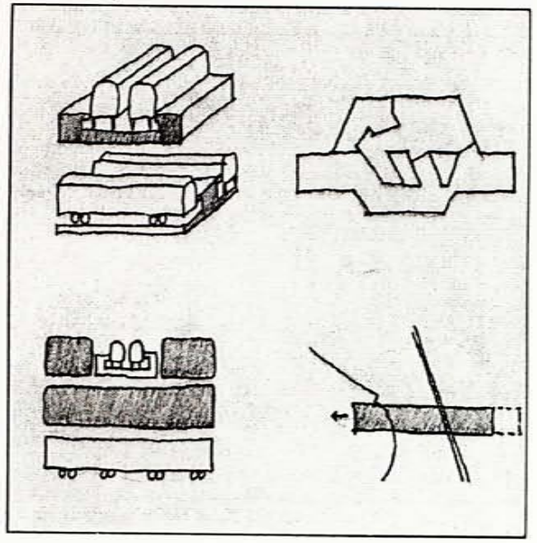

change of KCR or MTR platform level

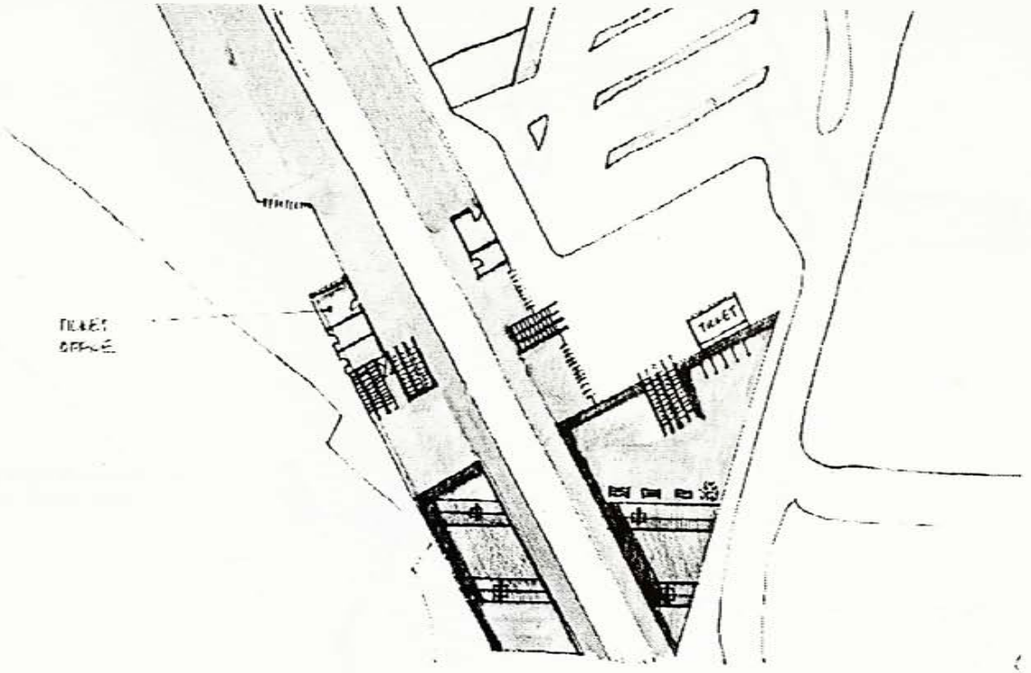


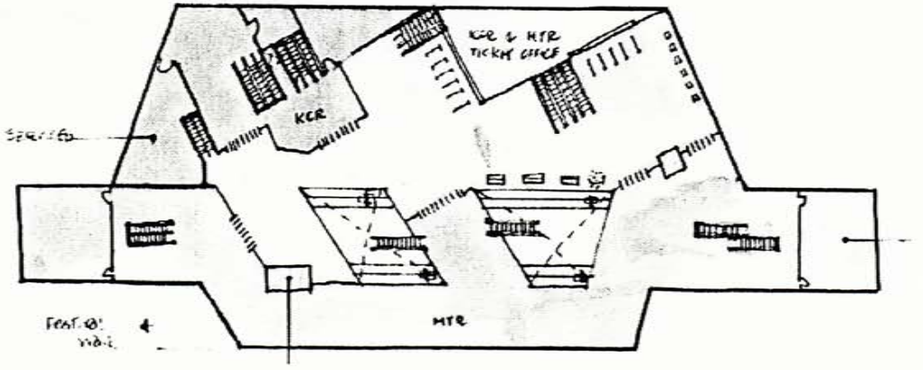
change of the MTR, KCR or both railway location

2.2 Design Options

Option One





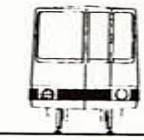


Pros:

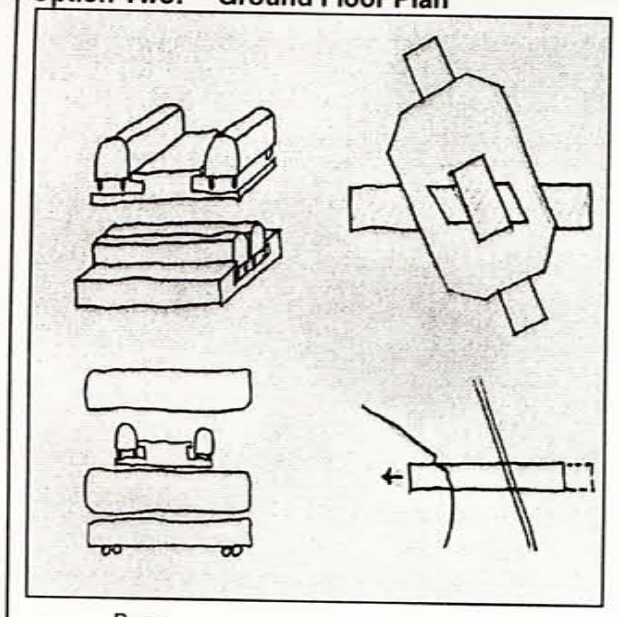
- The horizontal distance between KCR and MTR platform is shortened.
- Different movement routes are separated to avoid disturbance by cross passenger flow.
- Double-storey void to allow visual connection between KCR railway and MTR.
- Void and the double-storey concourse allow natural lighting to underground concourse and MTR platform.

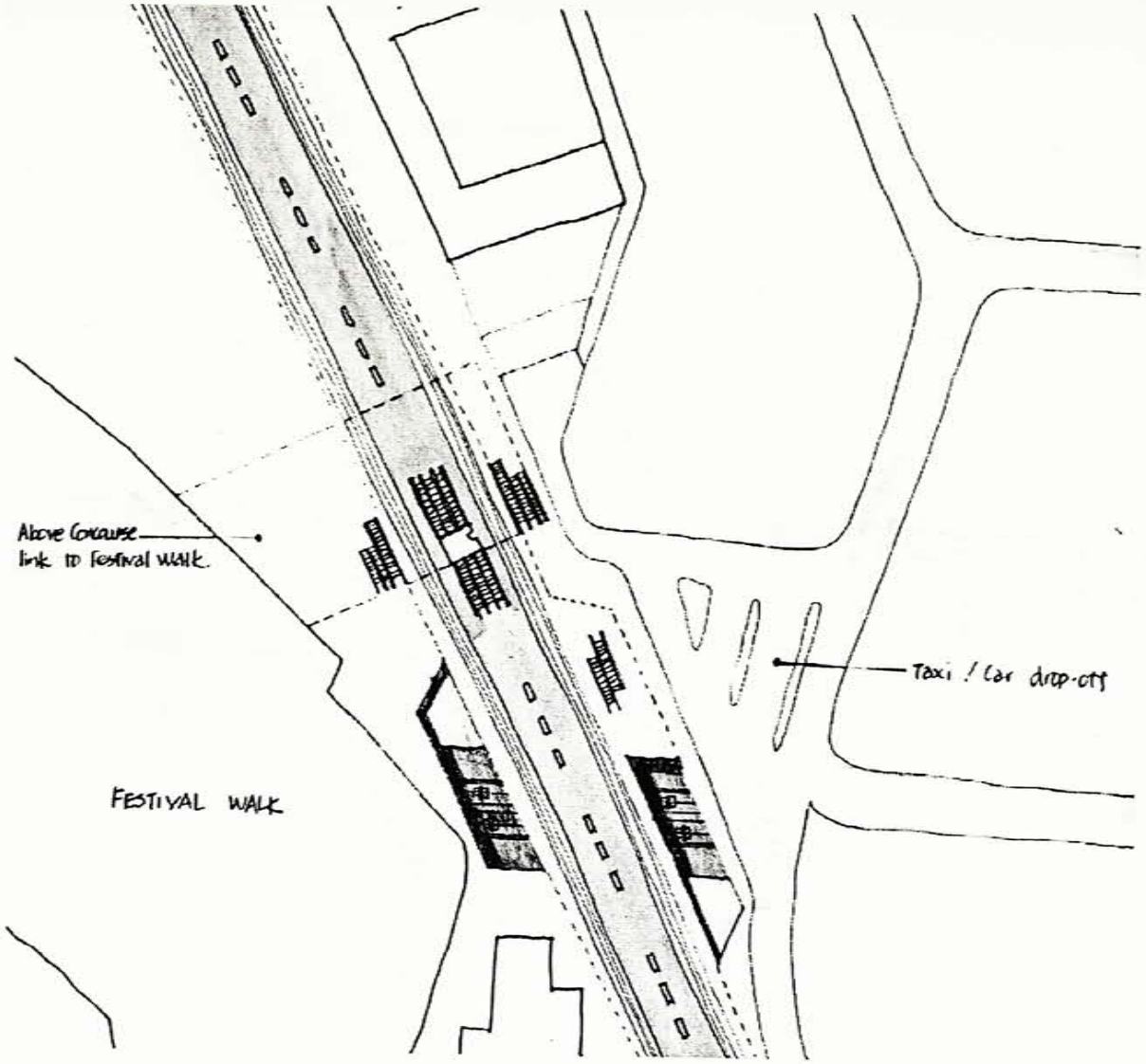
Cons:

- Not much space for auxillary facilities
- The platform width near HKPC is not much improved since the escalator landing location is much varied from the original condition.
- The visual connection between KCR and MTR to enhance the identity of an interchange may be unclear.



Option Two: Ground Floor Plan





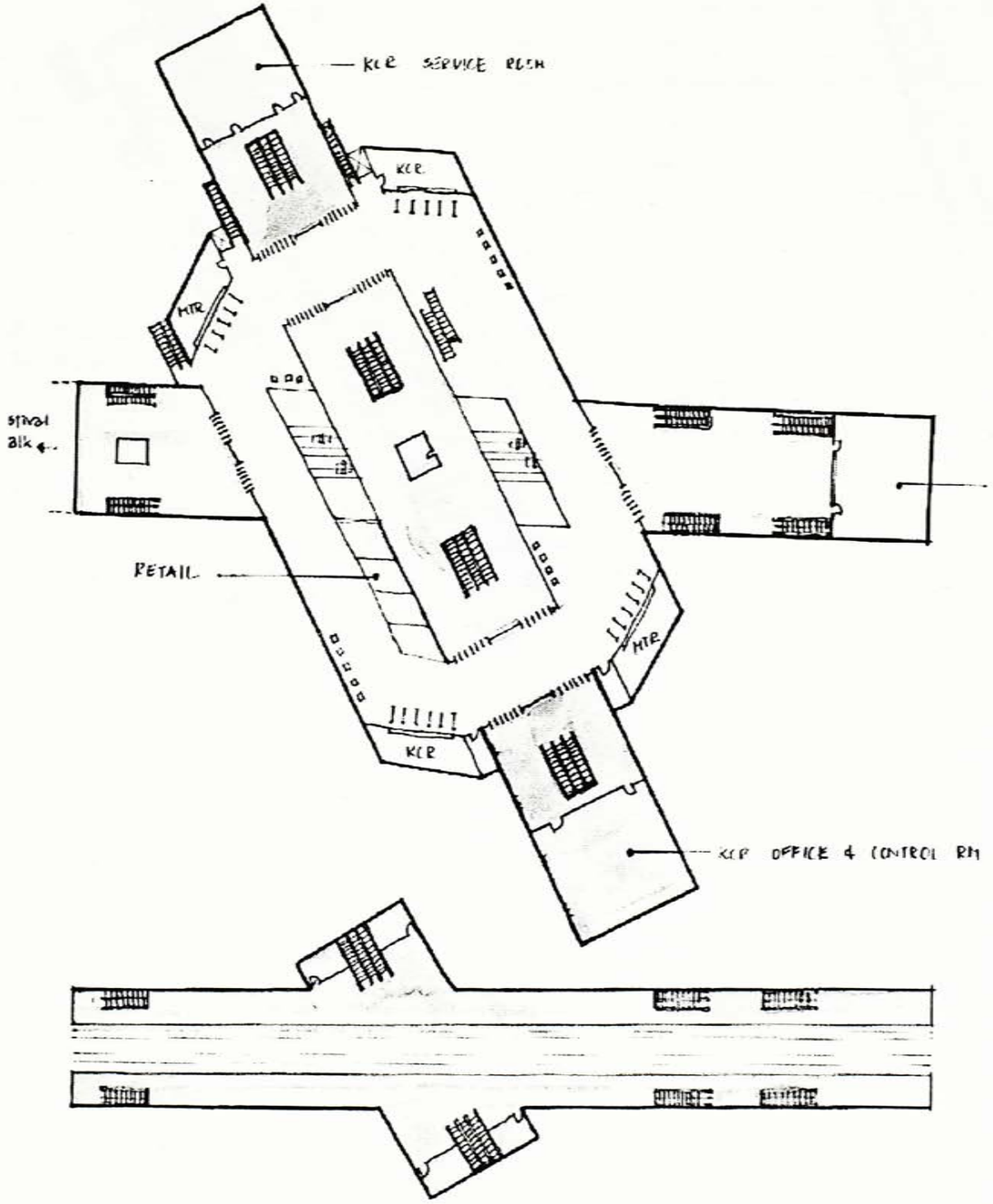
Pros:

- The horizontal distance between KCR and MTR platform is shortened.
- Different movement routes are separated to avoid disturbance by cross passenger flow (nearly a direct vertical route between KCR and MTR)
- Visual connection between KCR and MTR.
- Allow natural lighting to underground space.
- Above-track concourse separate the local residents and the users from the Festival Walk from the interchange passengers on underground concourse.

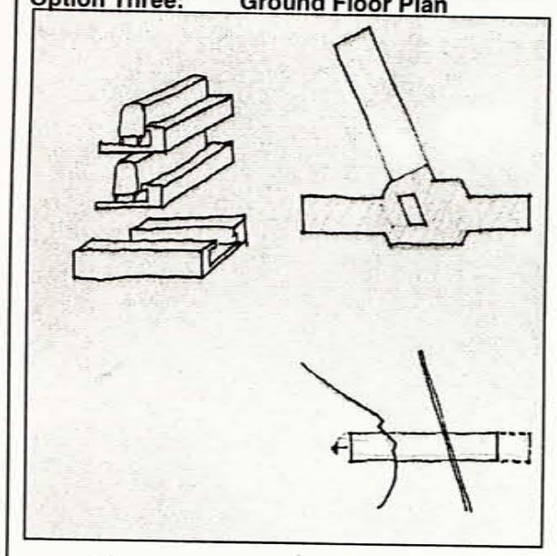
Cons:

- Passengers cannot enter directly to KCR platform from ground level - that implies lift or ramp is needed for disabled.
- Since the platform width near HKPC is restricted by the surrounding development (private property) the platform width is not much improved and even creates a bottle-neck near the escalators.

Option Two: Underground Concourse Plan



Option Three: **Ground Floor Plan**

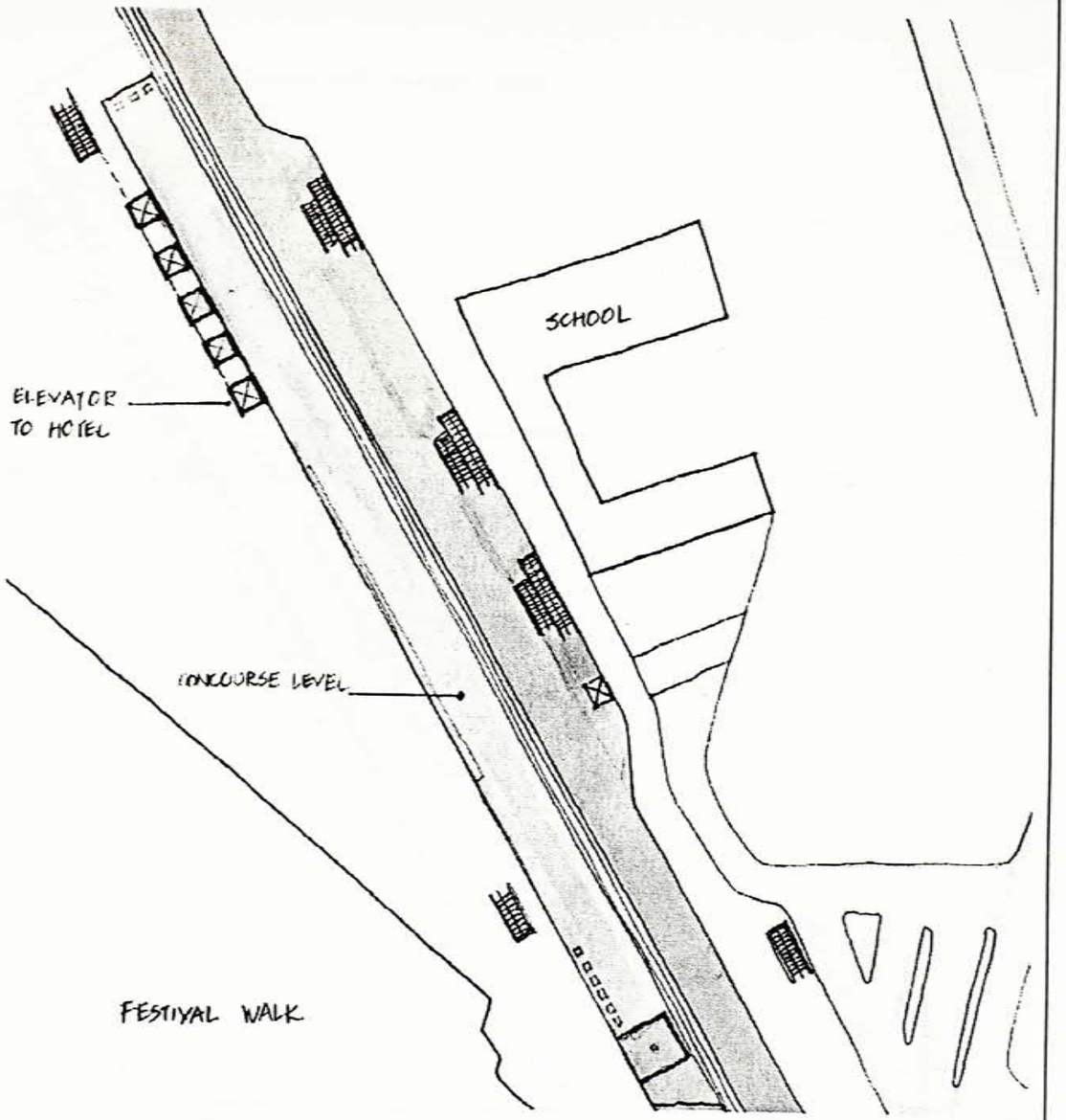


Pros:

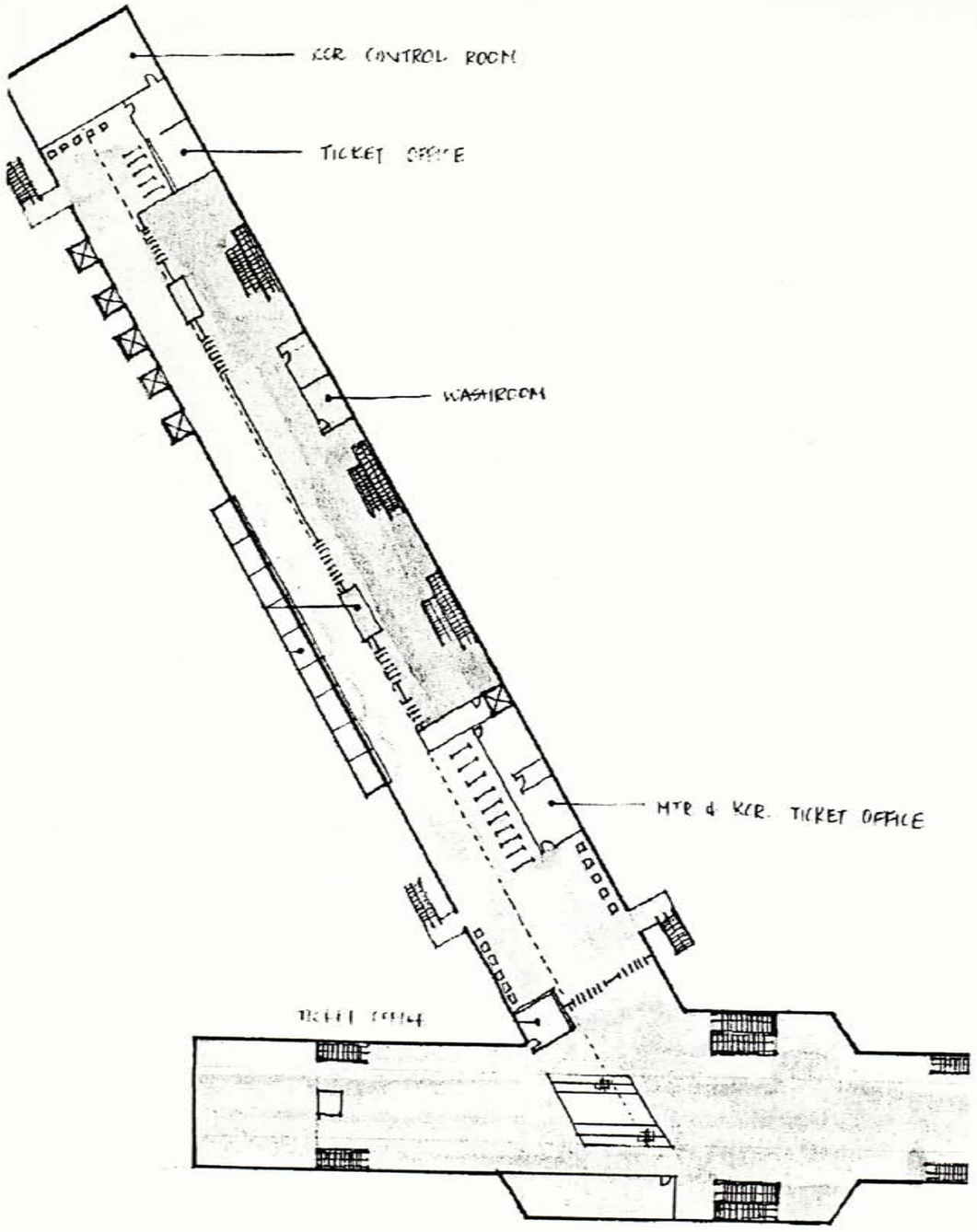
- The width of the platform is increased.
- Allow more natural lighting to the underground concourse.
- The routes are direct and obvious.
- Clear separation of MTR and KCR.
- More space for auxiliary facilities.

Cons:

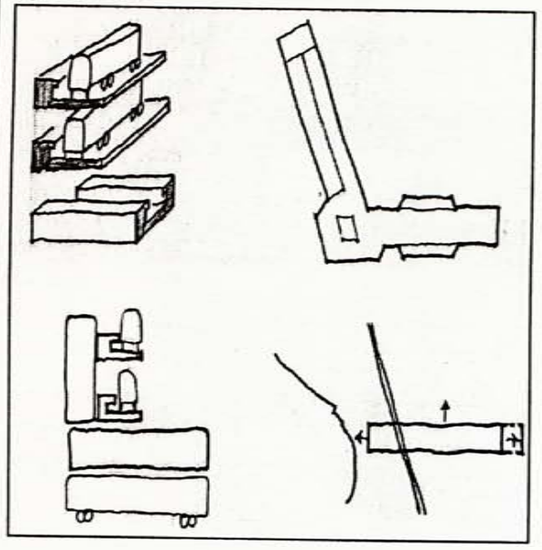
- The horizontal distance from KCR and MTR is lengthened.
- The visual connection between KCR and MTR is not enough.
- Lot of re-routing work is needed.

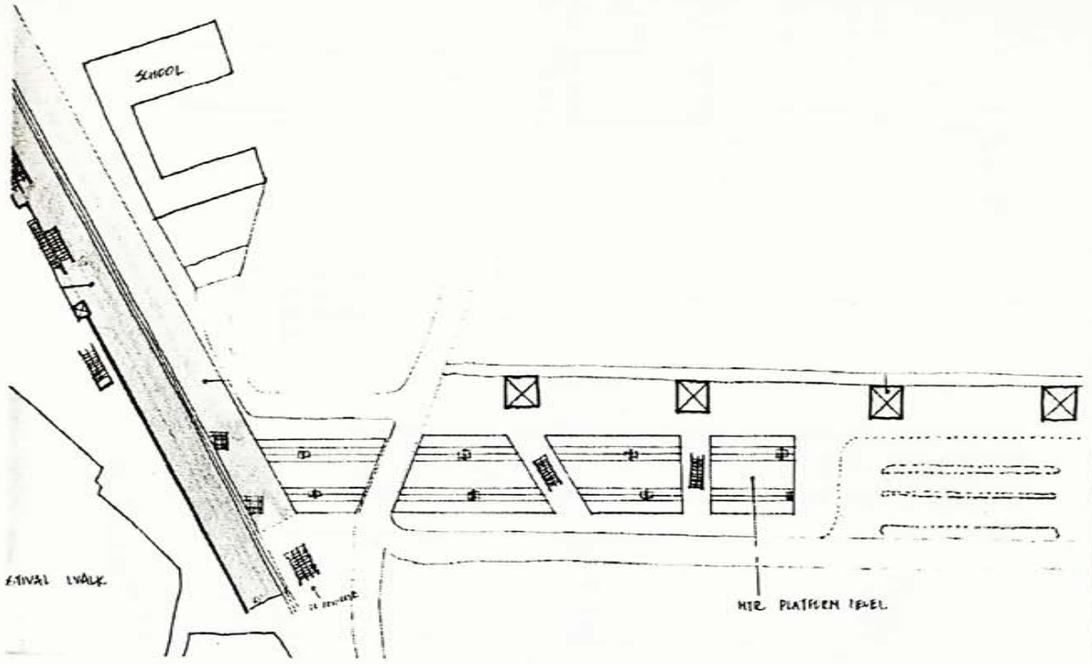


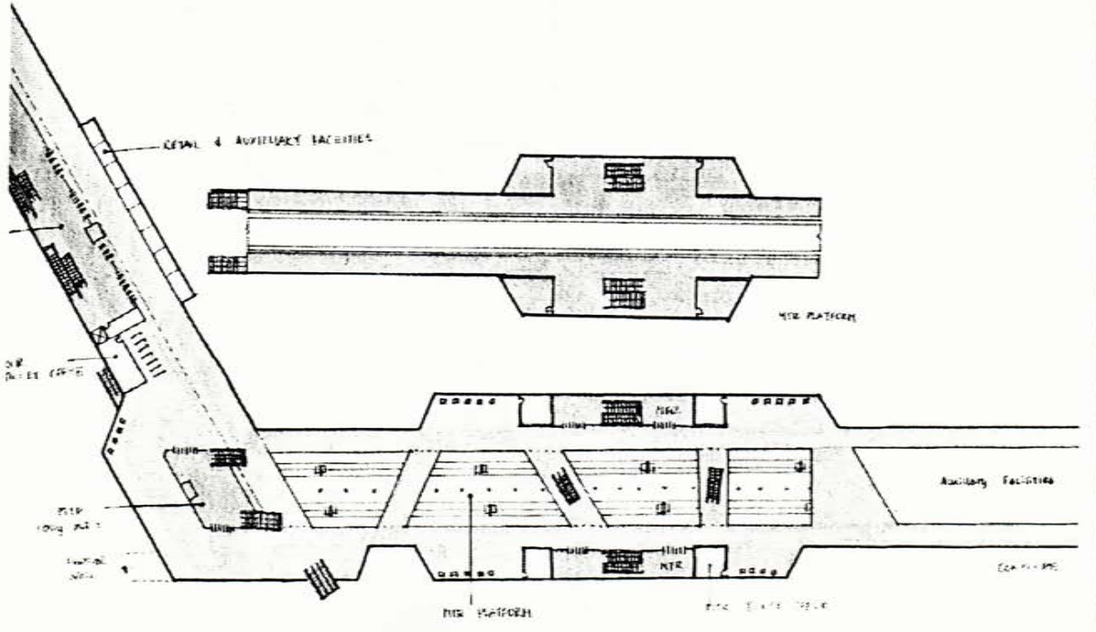
Option Three: **Underground Concourse Plan**



Option Four:







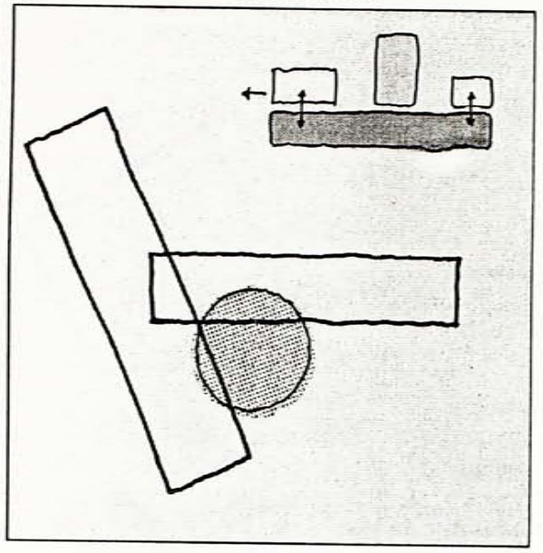
Pros:

- The platform width is much increased.
- More visual connection between KCR and MTR platform.
- Flexible for adding linkages to future development nearby like St. George's School and the military site.
- Able to accommodate more auxiliary facilities.
- Passenger flow is separated into different route.
- More natural lighting to MTR and concourse level.
- The horizontal distance from MTR and KCR is shortened.

Cons:

- The horizontal distance from KCR to MTR is lengthened.
- Lot of re-routing work is needed.

Option Five: Ground Floor Plan

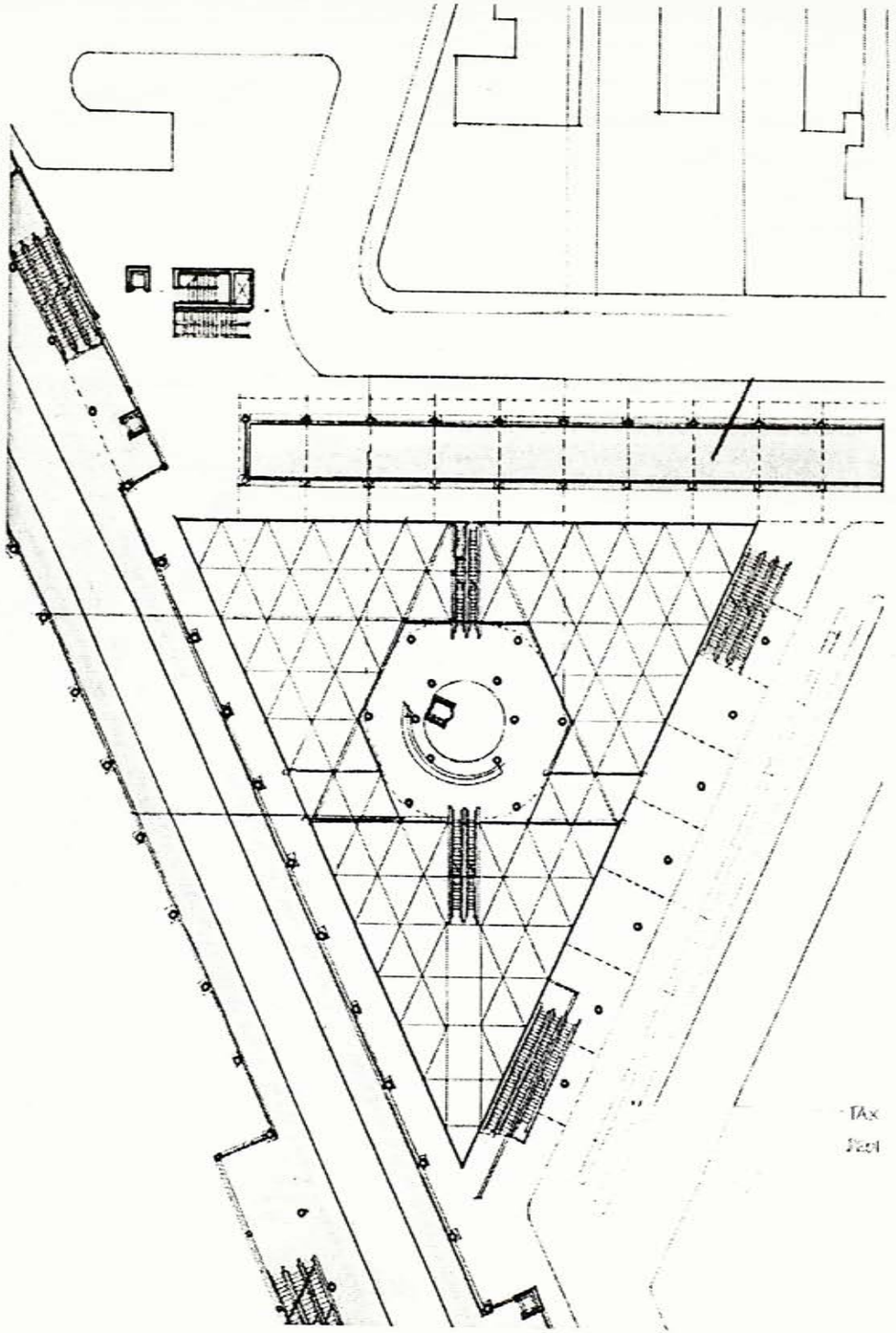


Pros:

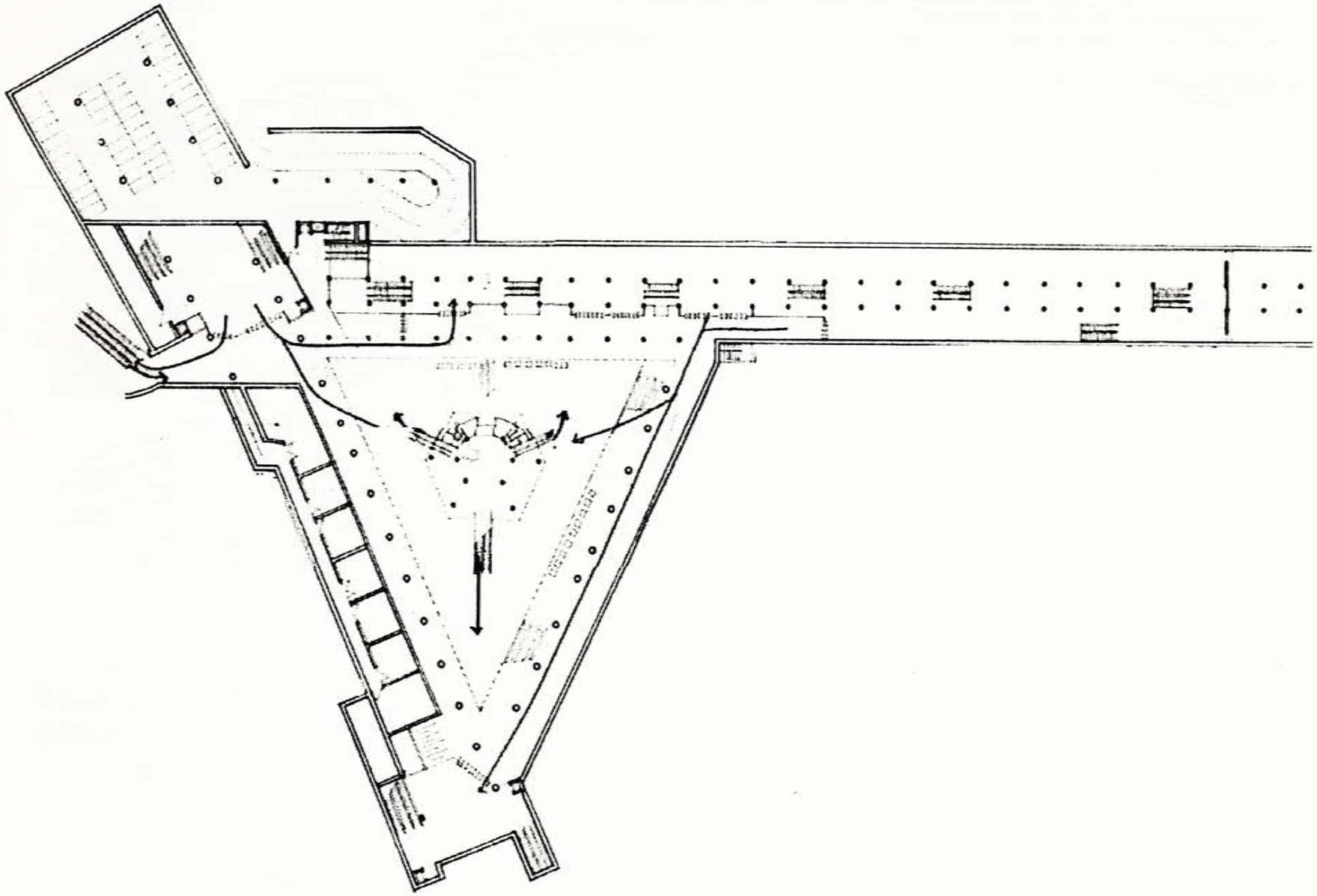
- No need to change the existing railway tracks.
- Using a vacant adjacant site allows construction work without much disturbance to the daily operation.
- Clear separation of different passenger flow.
- Flexible for adding linkages to future development of adjacent sites.
- Having a spacious concourse for accommodating various auxillary facilities.

Cons:

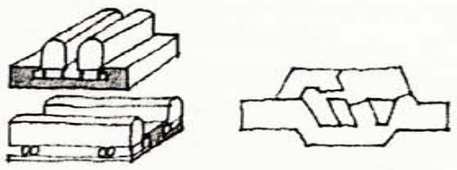
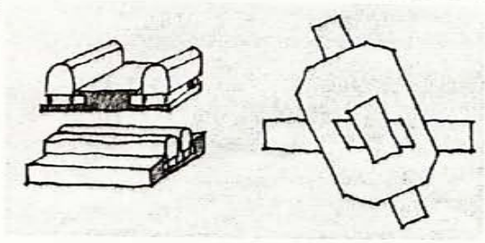
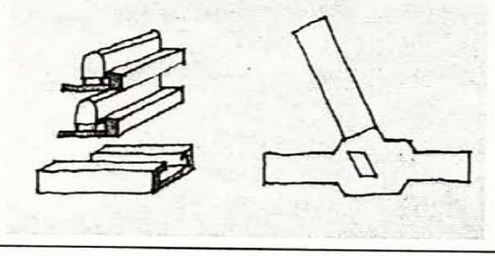
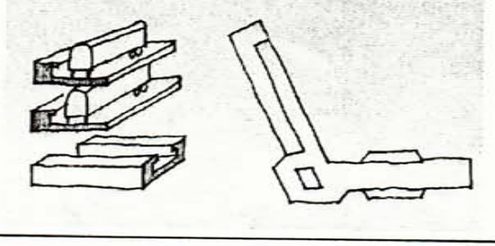
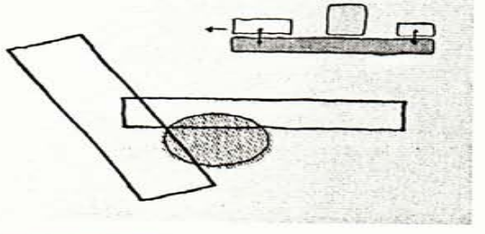
- The horizontal distance from MTR to KRC is lengthened.

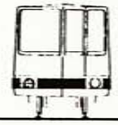


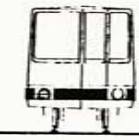
Option Five: Underground Concourse Plan



Pros & Cons of the options

Options	Pros	Cons
1 	- The horizontal distance between KCR and MTR platform is shortened. - Different movement routes are separated to avoid disturbance by cross passenger flow. - Double-storey void to allow visual connection between KCR railway and MTR. - Void and the double-storey concourse allow natural lighting to underground concourse and MTR platform.	- Not much space for auxillary facility. - The platfrom width near HKPC is not much improved since the escalator landing location is not much varied from the original condition. - The visual connection between KCR and MTR to enhance the identity of the interchange may be unclear.
2 	- The horizontal distance between KCR and MTR platform is shortened. - Different movement routes are separated to avoid disturbance by cross passenger flow. - Visual connection between KCR and MTR. - Allow natural lighting to underground space. - Above-track concourse separate the local residents and the users from Festival Walk from the interchange passengers on the underground concourse.	- Passengers cannot enter directly to KCR platform from ground level. - Since the platform width near HKPC is resticted by the surrounding development, the platform width is not much improved and even creates a bottle-neck near the escalators.
3 	- The width of the platform is increased. - Allow more natural lighting to the underground concourse. - The routes are direct and obvious. - Clear separation of MTR and KCR. More space for auxillary facility.	- The horizontal distance from KCR and MTR is lengthened. - The visual connection between KCR and MTR is not enough. - Lot of re-routing work is needed.
4 	- The platform width is much increased. - More visual connection between KCR and MTR platform. - Flexible for adding linkages to future development nearby like St. George's School and the millitary site. - Able to accommodate more auxillary facilities. - Passenger flow is separated into different routes. - More natural lighting to MTR and concourse level. - The horizontal distance from MTR to KCR is shortened.	- The horizontal distance from KCR to MTR is lengthened. - Lot of re-routing work is needed.
5 	- No need to change the existing railway tracks. - Using a vacant adjacant site allows construction work without much disturbance to the daily operation. - Clear separation of different passenger flow. - Flexible for adding linkages to future development of adjacent sites. - Having a spacious concourse for accommodating various auxillary facilities.	- The horizontal distance from MTR to KRC is lengthened.





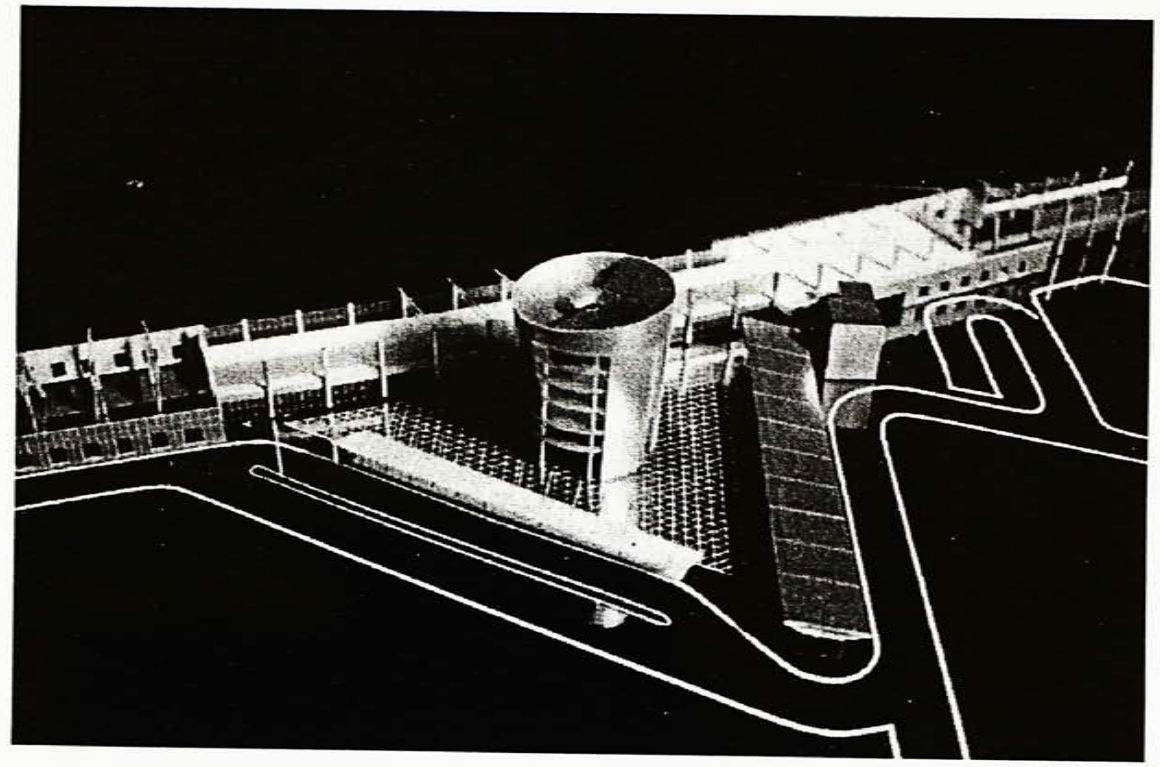
3.0 FINAL PROJECT

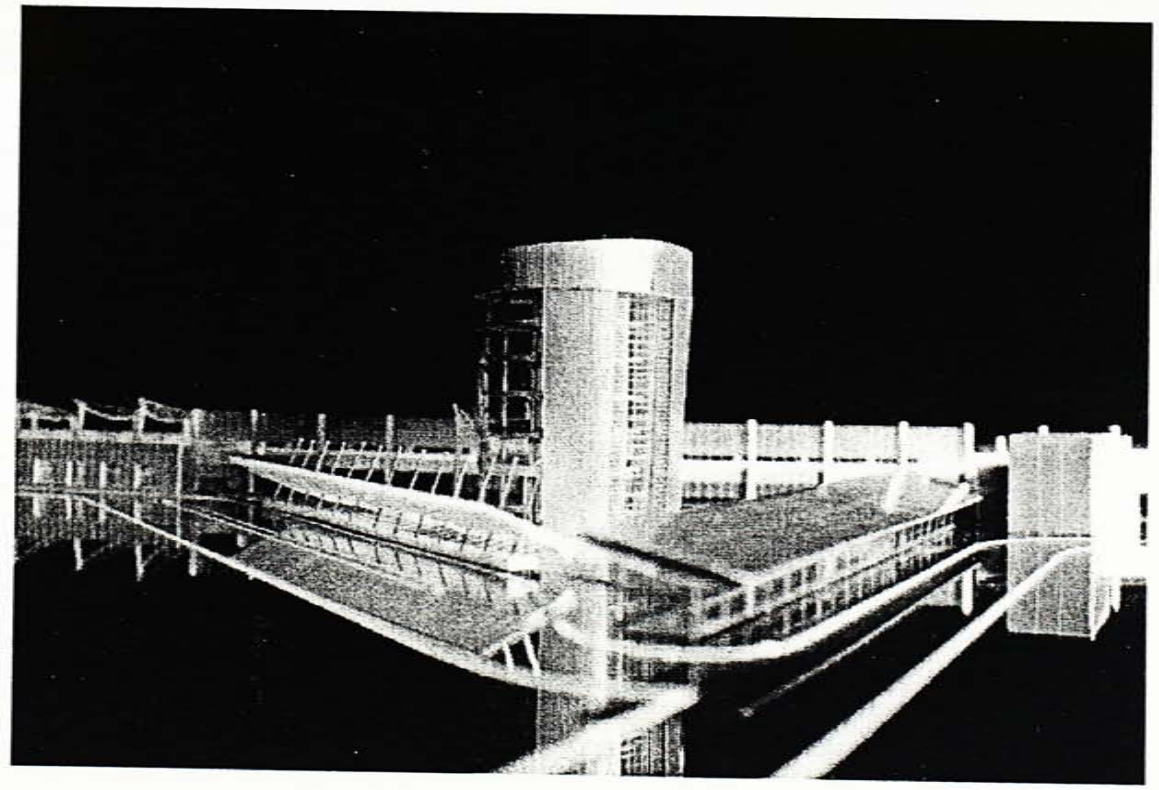
3.1 Introduction

In order to accommodate enough axuxillary facilities needed for the interchange, the whole complex includes:

- an underground MTR platform
- an underground interchanging concourse
- a KCR platform at ground level
- a KCR concourse serving as a link between east and west above KCR railway track
- a car and taxi drop-off
- an office building to accommodate different auxillary activities:

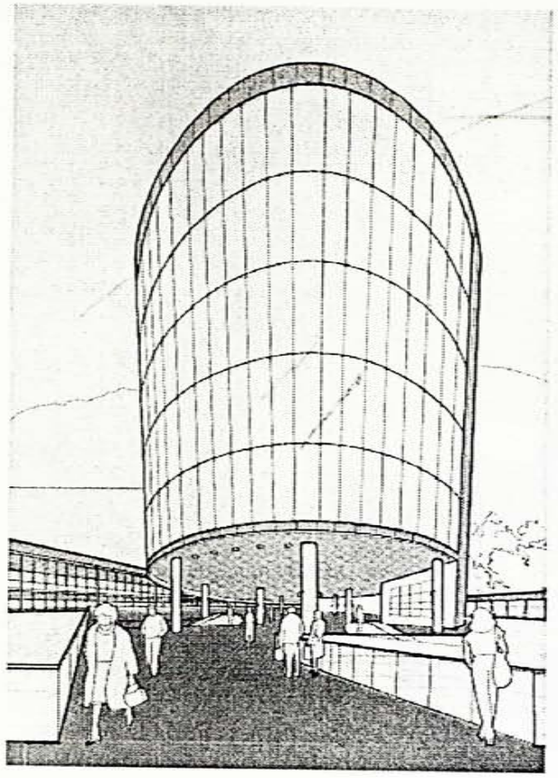
1. KCRC administration offices
2. KCRC customer services
3. Exhibition corner for KCRC
4. Tourist information
5. Ticket Booking Center
6. Post office
7. Rental offices

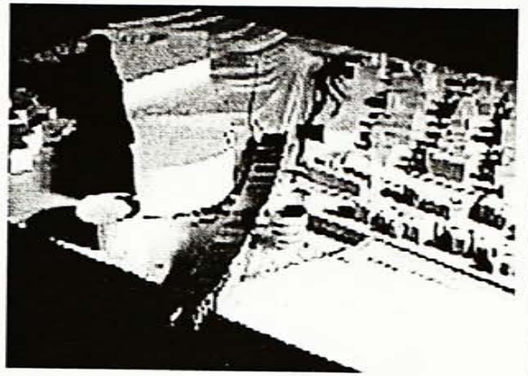


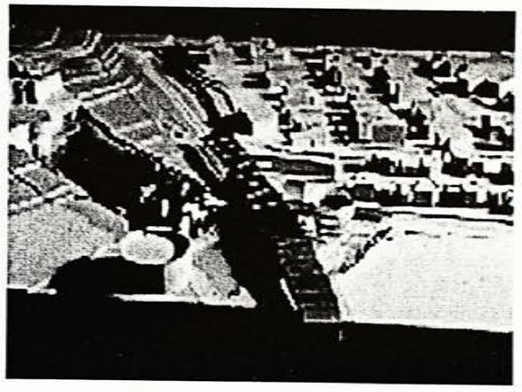


3.2 Design Strategy

As the whole complex consisted of several elements, it is intended to create a focal point for the whole complex. The central core, which is a 6-storey office building, is the tallest element among other elements and it becomes the focal point of the interchange. The treatment of each element shares some similar language,e.g, same language for the shed above MTR and KCR platform, so that each echo to each other and forms a united interchange complex. As the intersection between the MTR and KCR naturally forms a triangular space in between, the central core is decided to be in another primitive shape which is a reformed cylinder at last.







3.3 Site Aspect

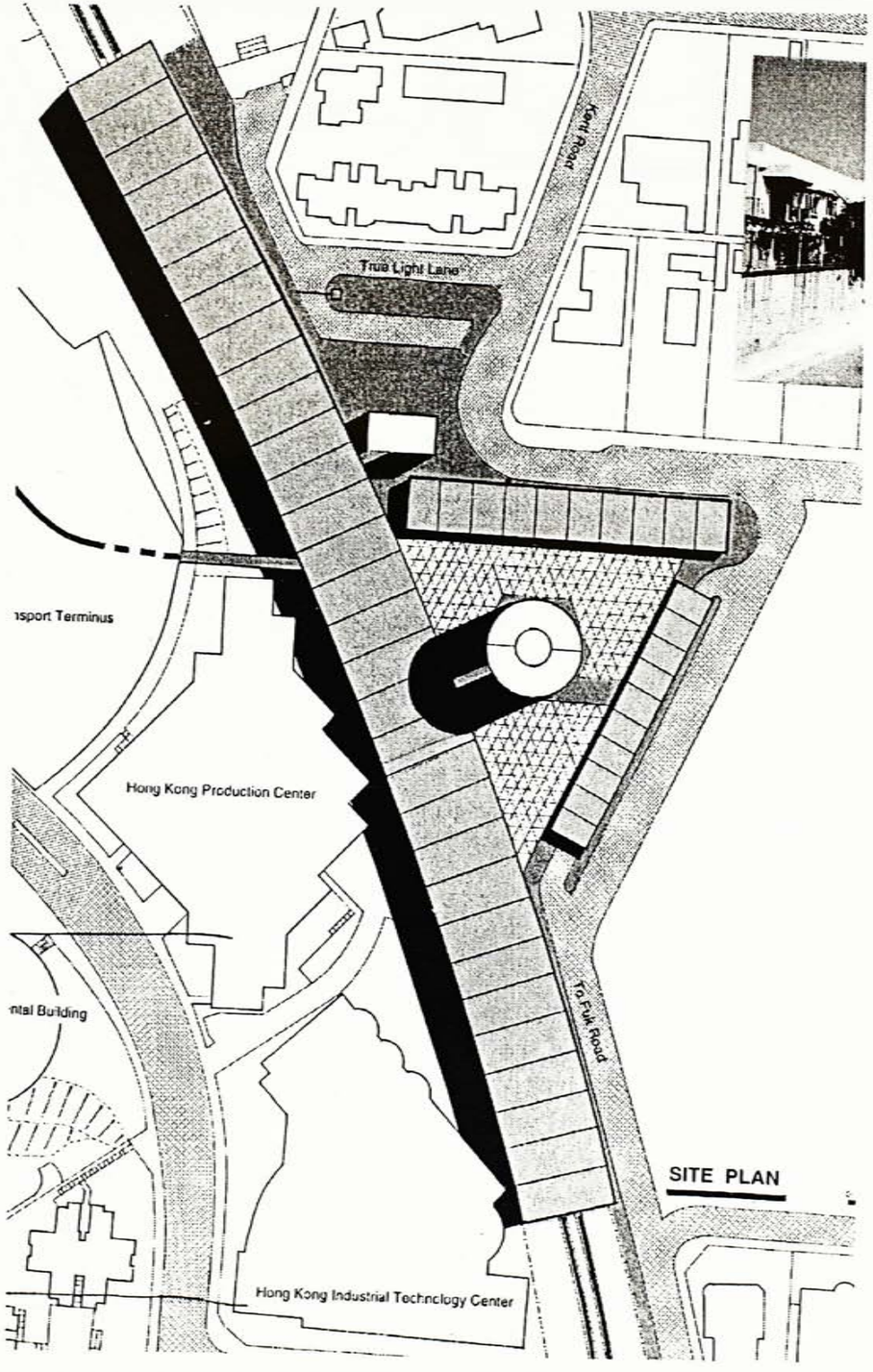
3.3.1 Vehicular Access

In order to obtain a complete site for the interchange,. To Fuk Road needs to be re-routed. Although there will be a public transportation terminus for bus, GMB and taxi, located in the Festival Walk, there is still a need for taxi-stand and drop-off area for cars on the east side of the station.

3.3.2 Pedestrian Access

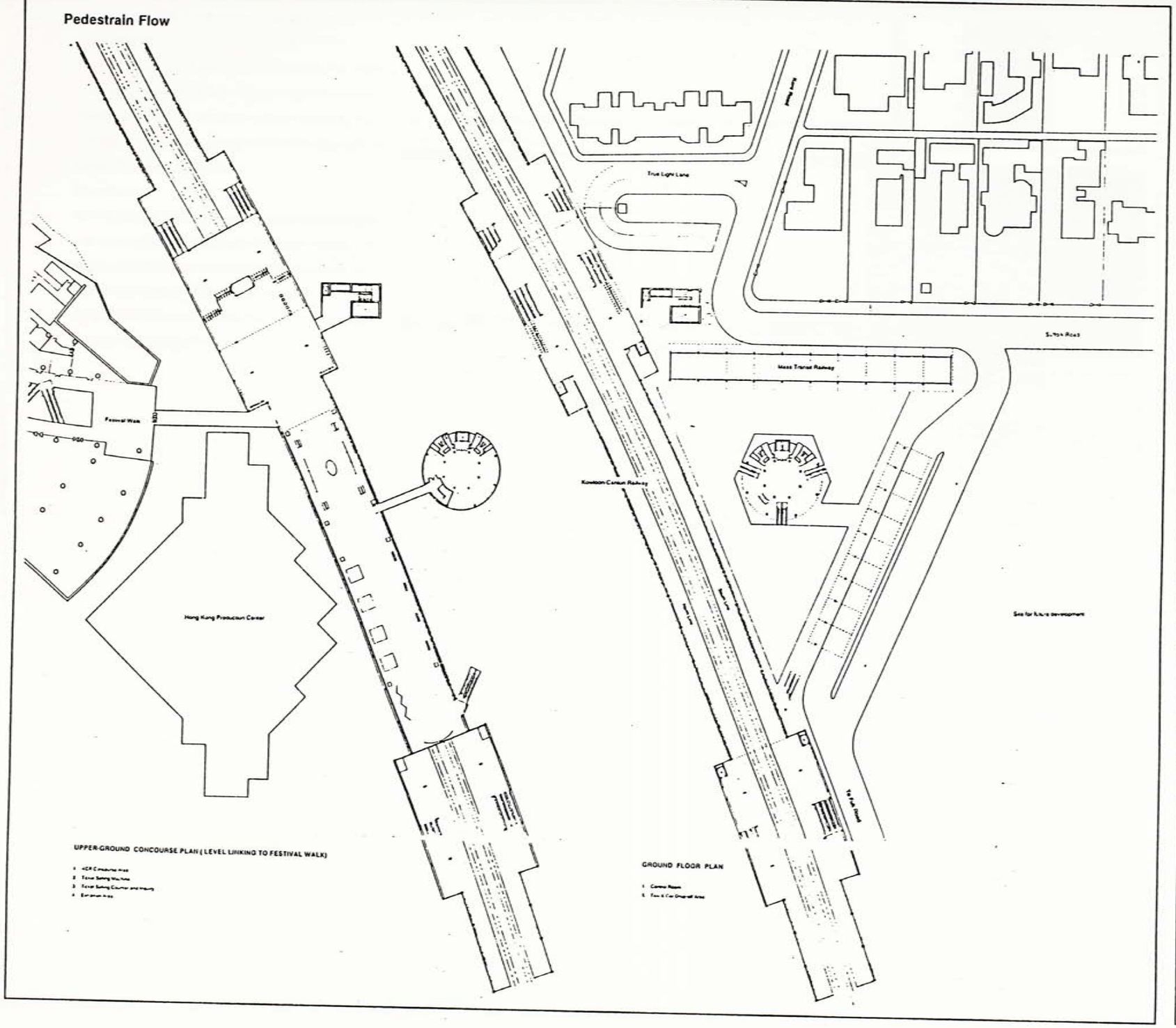
The KCR railway separates the region into east and west portions and therefore the station acts also as the linking node for the pedestrian between east and west. A 24-hour open access is therefore provided. The route will link to the 24-hour open route in Festival Walk to form a passage running from the east of the station, the concourse above KCR railway track, Festival Walk and to the City University of Hong Kong.

Since there will be new development on the St. George's School site and the military site next to Waterloo Road, possible entry point to the underground concourse is considered.



SITE PLAN

Pedestrain Flow



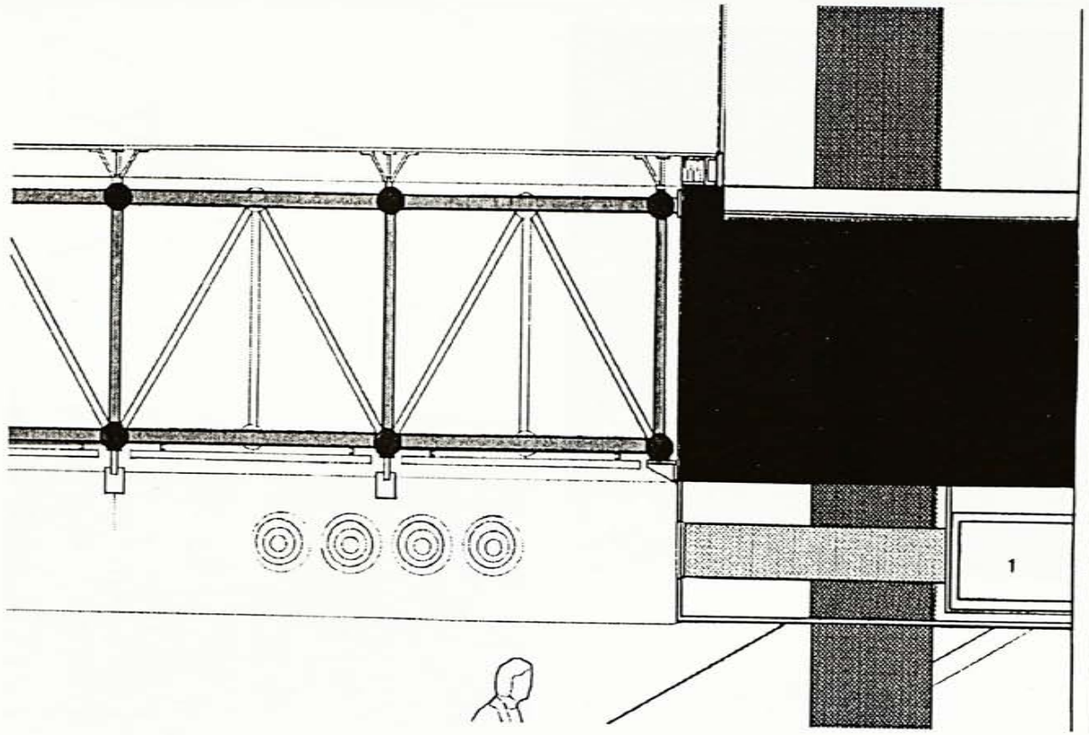
3.5.2 Underground interchanging concourse

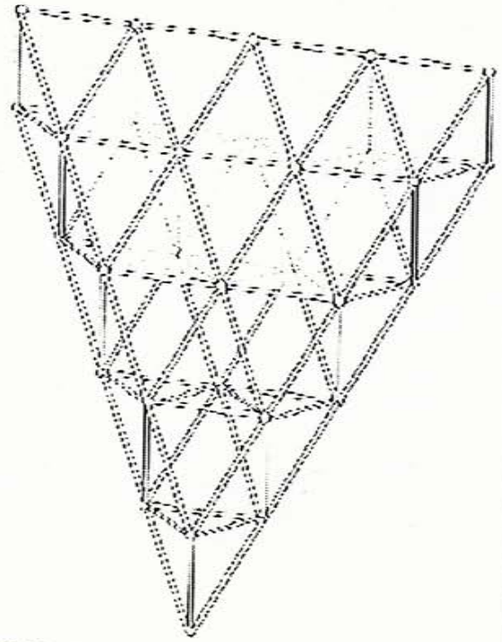
Daylighting

As the roof is all in glazing, to minimize the solar heat gain and have diffuse dayligthing in the underground concourse, the area without shading from surrounding building during most of the time will be shaded by shading devices.

Structure

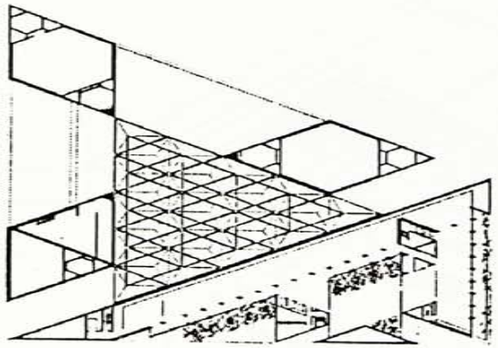
As the longest span of the glazed roof is about 90m, the most efficient structure is space frame. The structure is simiply a double layer space frame with triangular module. The space frame is 1.2 meter deep. It will be mansfactured in factory in big module and composited on site.

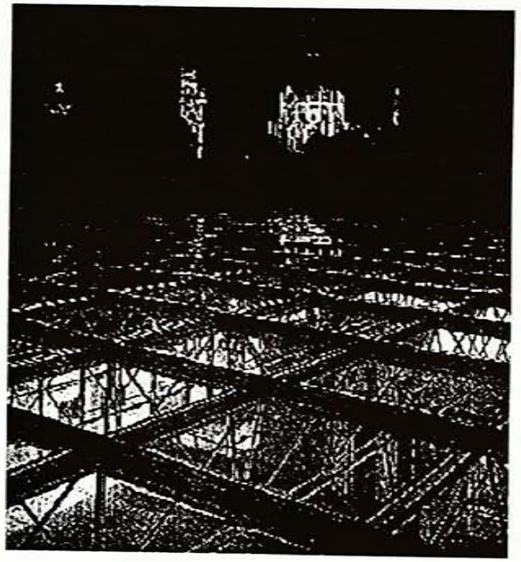


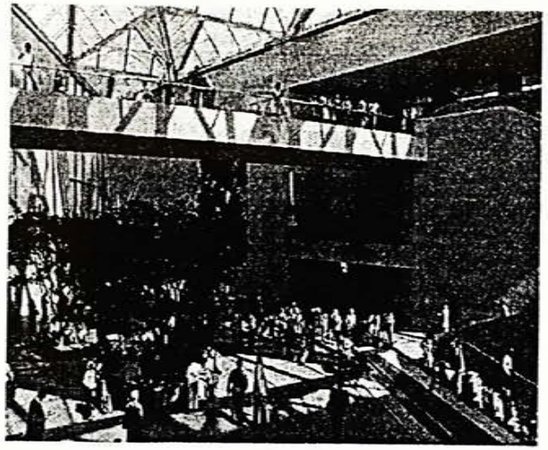


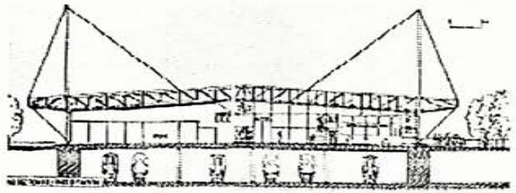
SPACE FRAME FOR THE GLAZED ROOF OF THE UNDERGROUND CONCOURSE

3.5.2a References of Glazed Roof Structure









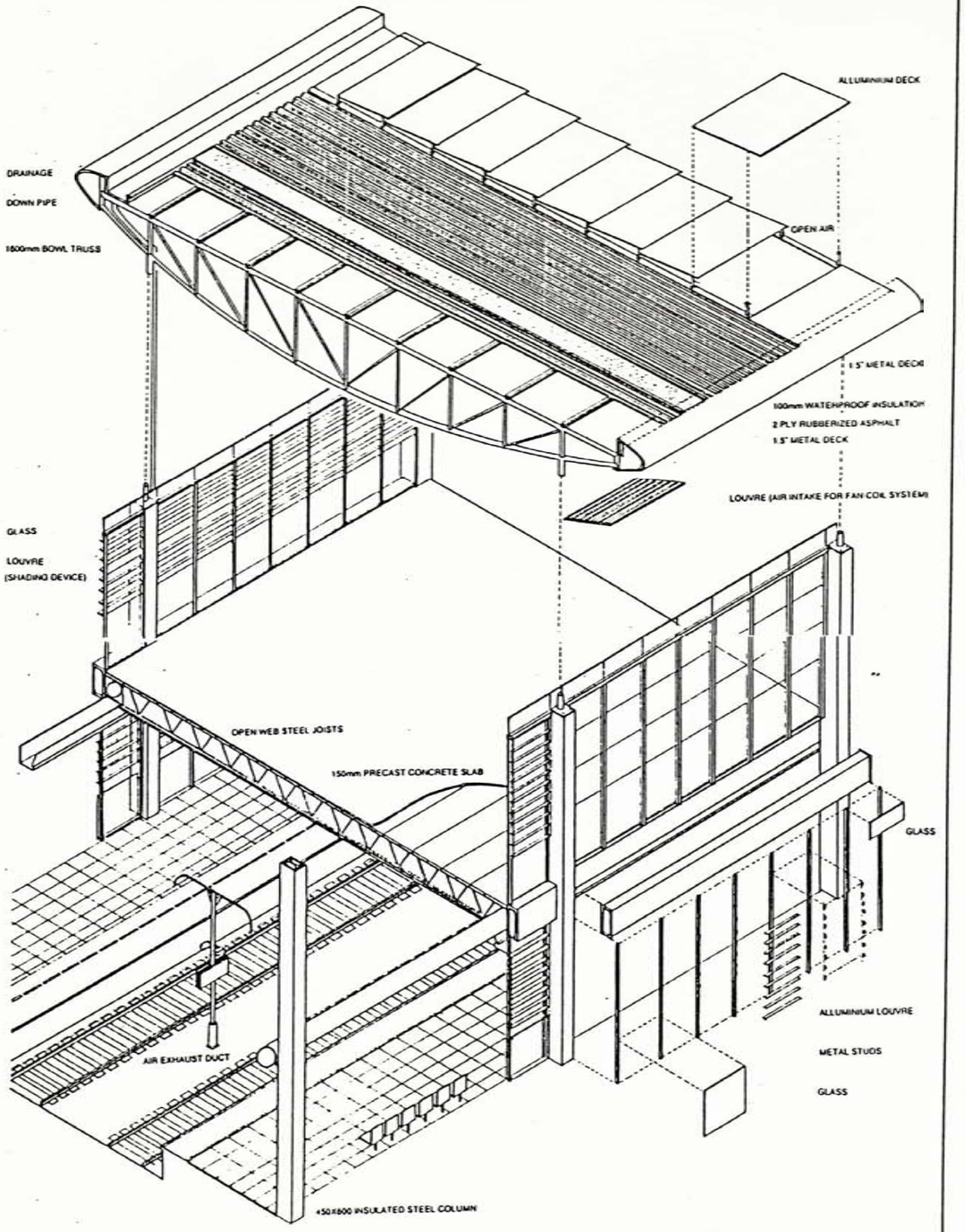
3.5.3 KCR platform at ground level

Design Strategy

As there is insufficent platform space, one improvement can be archieved by extending the platform width to the outer boundary of the site. Besides, to put the structural elements at the outer boundary also helps to improve the fluidity of passenger flow. Steel structure is selected as the size of structural memebers for long span, 16m in this case, is smaller than using concrete. Moveover, in order to cause less disturbance to KCR daily operation, a fast construction process is needed. Therefore, the envelope of the building will be composed of modules that can be manufactured in factories and fitfed in the structural framework on site.

Environmental Concern

Since the platform is at ground level and the surrounding environment is not highly polluted, natural ventilation, like the existing condition, is desirable. However, as the major building facades are facing east and west, sun shading device is needed. As the building allows for natural ventilation, the opening should be protected from heavy rain. Besides, certain level of visuability between interior and exterior is emphasis. There is a requirement for a building envelope that can allow natural ventilation, certain level of visuability, weather protection from sun and rain. The devices used to fulfil one target perfectly may be a contradiction to other target. Therefore, certain trade-off is made to create a faced design that can achieve the requirements as much as possible. (fig1 explosed axon)



3.5.4 KCR concourse above railway track

Sun Shading

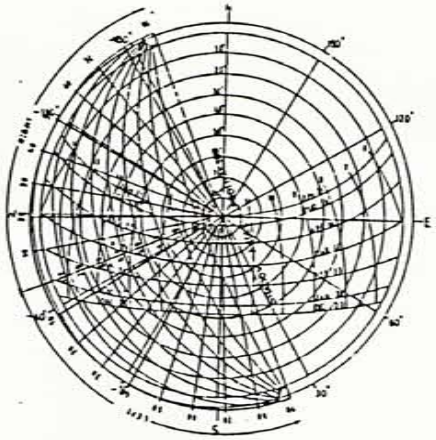
As it is an enclosed air-conditioned space partially for exhibition, vertical screen that is most efficient for sun shading is used.

Lighting

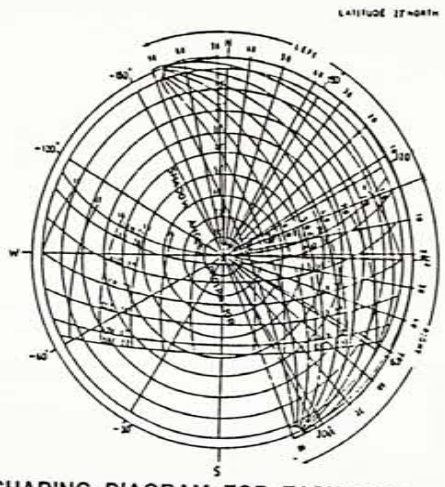
There is suspended ceiling following the curve of the bowl truss. Artifical light is installled behind the suspended ceiling to light up the curved roof and creates diffusion light to the space.

Drainage

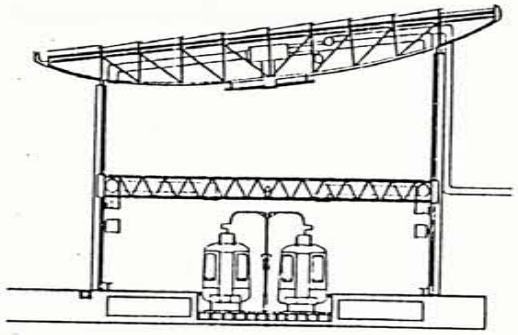
The rain water drains along the corrogated metal roofing to the end pipe and goes to the ground drainage through the down pipe which runs along the west side columns.



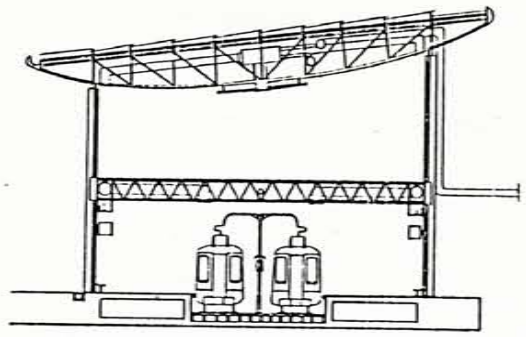
SHADING DIAGRAM FOR WEST FACADE



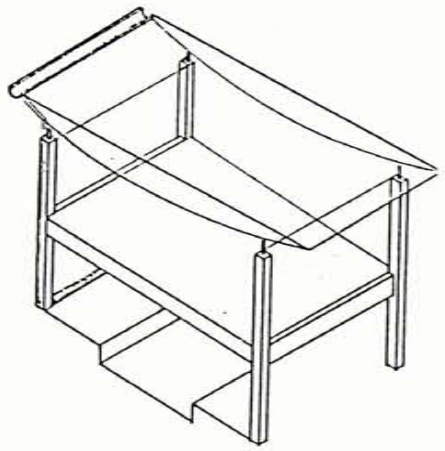
SHADING DIAGRAM FOR EAST FACADE



SHADING EFFECT (AUG 4:00PM)



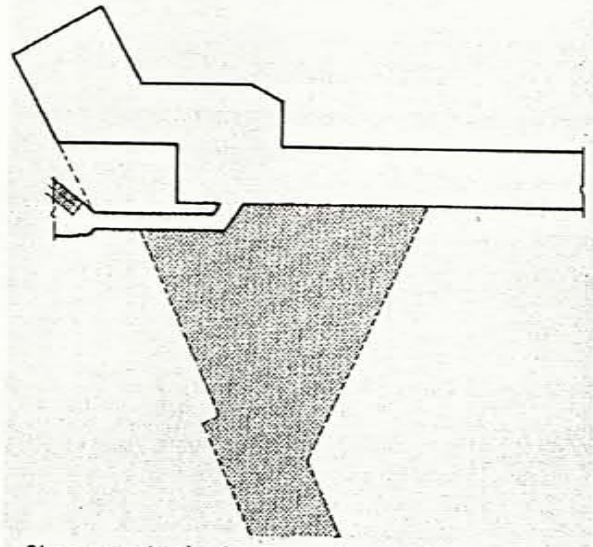
SHADING EFFECT (AUG 9:00AM)



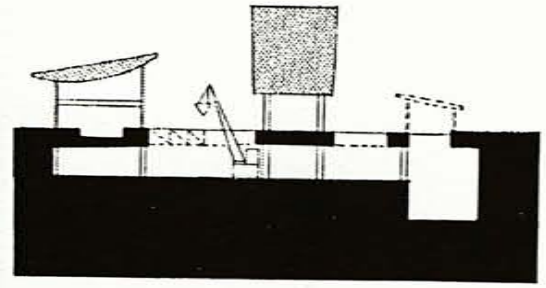
ROOF DRAINAGE SYSTEM

3.6 Construction Sequence

Re-routing To Fuk Road

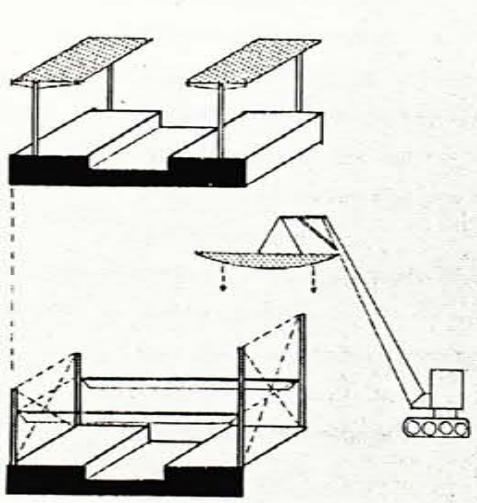


Site excavation for the new underground concourse

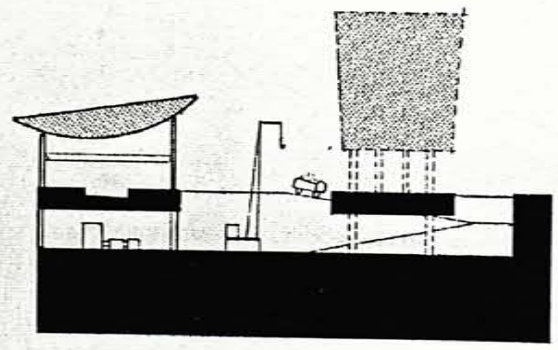


Construct the space frame & the glazed roof

Deconstruct the existing roof above KCR platform



& build the new one module by module

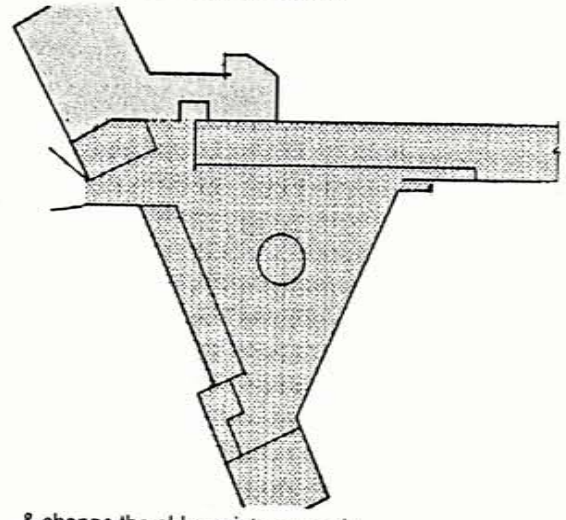


Construct the central core

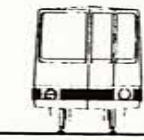
& move in the machines and services

Renovate the escalator system and gateway of MTR

Start the use the new concourse



& change the old one into car park



3.7 Special Study

3.7.1 HVAC system

There are two main type of air-conditioning system: one is the unitary package systems including window unit and rooftop self-contained unitary packaged system; the other is the central hydronic air conditioning systems. As there is no roof space for machine on roof top, rooftop self-contained unitary package air conditioning system is not suitable.

Possible HVAC system for the above-track concourse:

Window unit

Pro: High installation flexibility
Fast installation

Con: Great design impact to the elevation design

Central hydronic air-conditioning system

Pro: Heat capacity per ft3 of water is 3466 times higher than water

Con: Longer construction time for running pipe

- **Chilled water supply from floor**

1. Fan-coil unit near window

Pro: All pipe work can be concentrated under the floor of the concourse. That means no need for pipe work for the construction of the second floor that may shorten the construction time

Con: Air supply for the middle part of the space may be insufficient
More energy is consumed to compensate the heat gain on east and west facade

2. Fan-coil under the concourse floor with projected nozzle

Pro: Even distribution of cool air

Con: The nozzle creates great design impact to the space and makes the space less flexible for use

3. Rise-floor system

Con: Expensive installation cost
Frequent maintenance for floor air outlets

- **Chilled water supply from the roof**

1. Fan-coil molded on the roof

Pro: Even distribution of cool air
Maintain high flexibility of the spatial lay-out for exhibition

Con: Duct work on the roof that require longer construction time

3.7.2 Acoustic system

Sound absorbing materials can be categoried as follows:

- Absorptive materials: those that dissipate or con vert sound energy to heat

  Typically, they have a soft and porous structure fibrous base material. They can be diaphragmatic absorber or resonant absorber.

1. Porous absorptive materials: foams, fabrics, carpets, cushions, cork, minerial / glass fiber board, isocyranuate and ceramic fiber
2. Diaphragm absorbers:e.g, a panel is hung in front of a hard wall at a small distance from the wall, the air space will act as a complant element. Typical panel absorbers are gypsum board partitions, wood paneling and suspended ceiling.
3. Resonant absorbers: with cavities that continue a volume of air which is connected to the atmosphere by a small hole. They are useful for frequencies below 400hz, such as a break squeal noise.
4. Others: Spray-on absorbers which are up to 2 inches and can be used for fire-proofing / thermal resistance but with poor aesthetics and durability.

- Barrier materials: those that block sound waves

  They are hard, heavy and very reflective. Lead is good sound barrier but costly. Therefore, a combination of materials are usually used to form a composite system.

- Vibration isolation / damping materials: those that reduce radiated sound

  They prevent the vibration of one object from being transferred to another object, e.g, by using spring or resilient mounts.

- Silencer: those that suppress sounds

  Passive siliencers include common automuffler to suppress specific noise sources. Active siliencers create sound waves that are out of phrase with original noise and the sound will be cancelled.

There are 4 groups of system for noise control:

- Sound absorptive systems
- Sound barrier systems
- Silencers
- Vibration control systems

For the station design, the major noise source is from the friction between the train wheels and the railway track. Therefore the envelope around the railway can be used for acoustic control. As side opening is needed for ventilation, the facade cannot be a good sound barrier to stop the sound to the surrounding environment. Therefore major sound control system can only be installed on top which is the ceiling under the upper concourse, and the area near the railway track which is space along the platform edges.

For ceiling system, sound absorptive system is most commonly used. For example, using sound absorbing pads which is fibrous behind a perforated steel deck system.

Silencers can be used under the platform to suppress the sound.

3.7.3 Shading Device

Effective shading devices for the east and west facade:

Movable blinds / curtains

Pro: Effectively block the transmission of the solar radiation through glazed windows

Con: When air flow is desirable, they seriously impede ventilation

Louvres

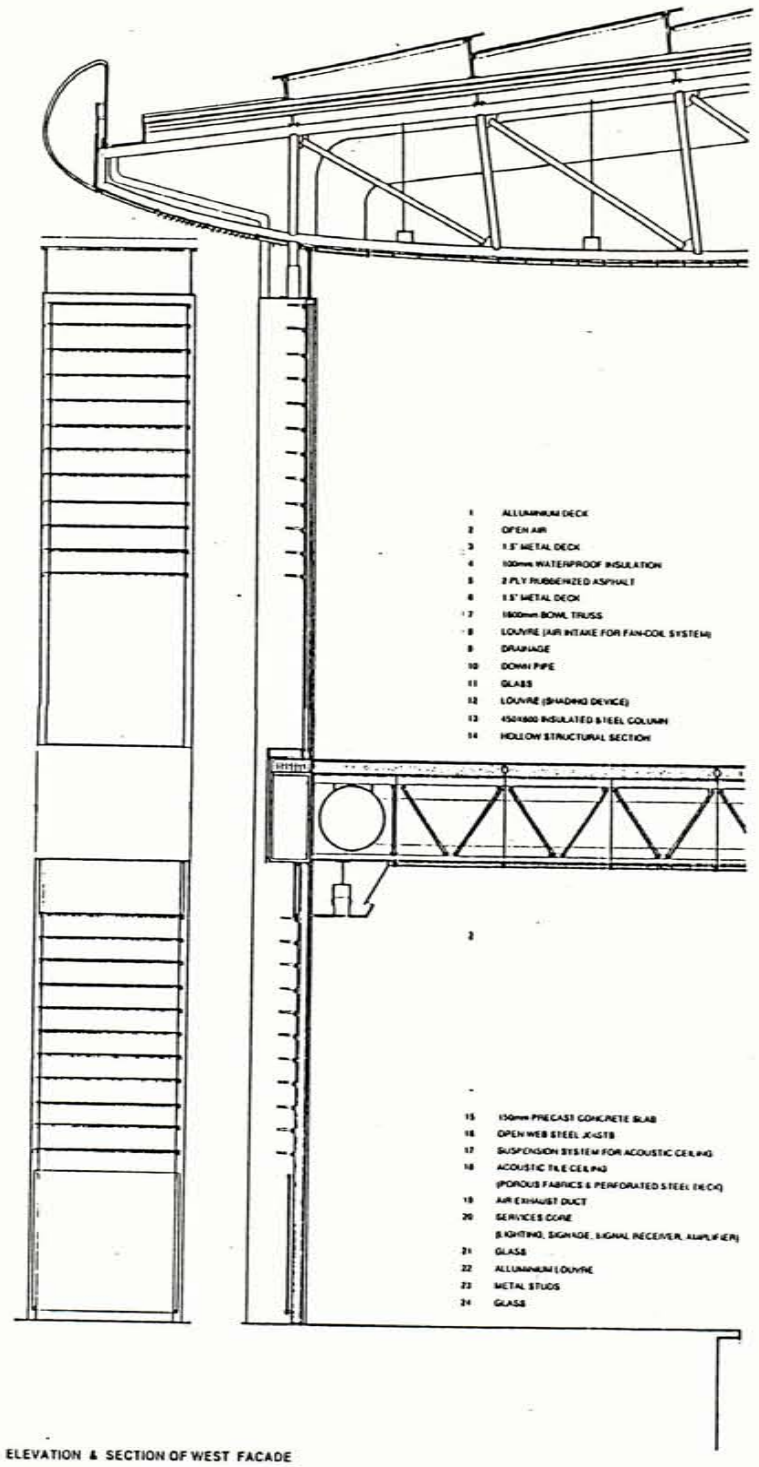
Pro: Either adjectable or fixed that can block the solar radiation effectively

Con: Affect view and air movement to some degree

Fixed overhangs

Pro: Give rain protection to the opening
Cause no effect on view and air movement

Con: Large overhang for sun shading



ELEVATION & SECTION OF WEST FACADE